Materials

& Methods

IN DESIGN ENGINEERING

NEW
NAME
FOR
Materials
& Methods
see page 101

SELECTION & USE OF METALS, NONMETALLICS, PARTS, FINISHES

[redacted] [redacted]

June, 1957

Selection and Design of Fluorocarbon Plastics—M & M Manual

Which Organic Coating?

How to Choose a Less Critical Material

Aluminum-Tin Bearings

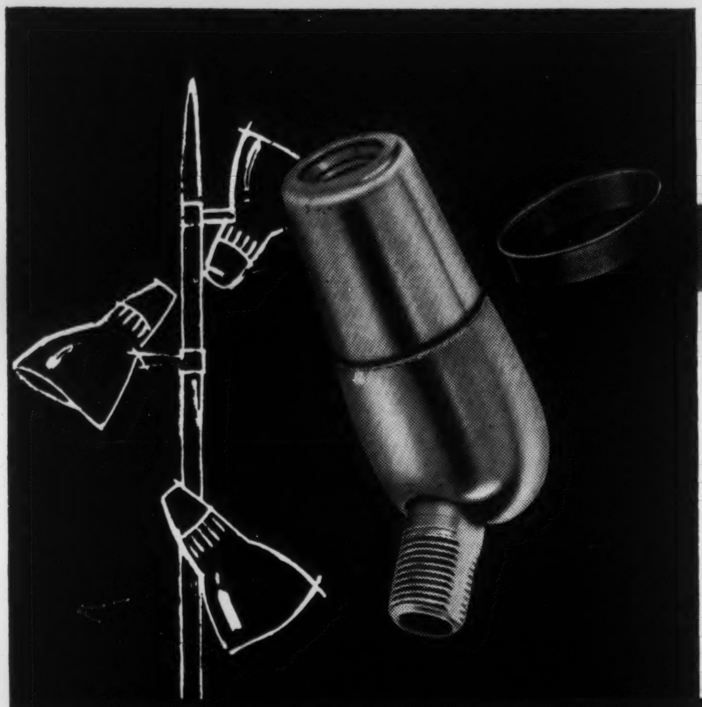
Selecting Silicone Rubbers

Where to Use Heat Resistant Castings

PRICE FIFTY CENTS

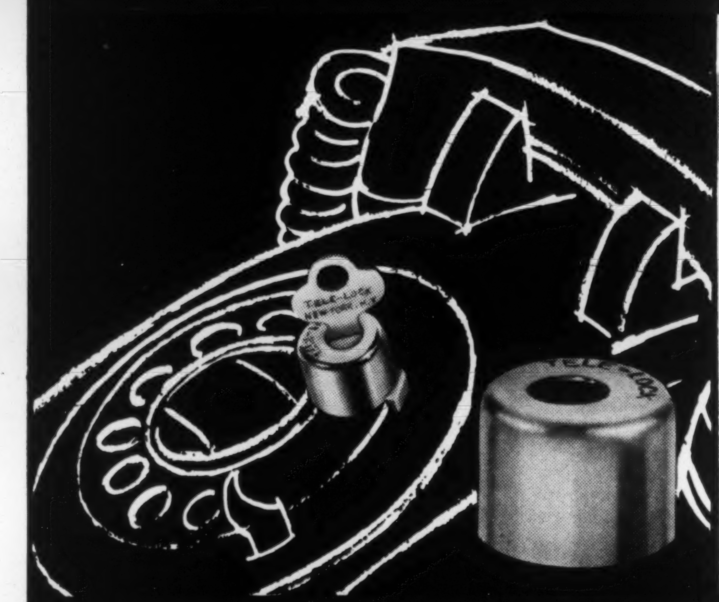
Complete Contents—page 1

How three manufacturers use Anaconda superfine-grain alloys



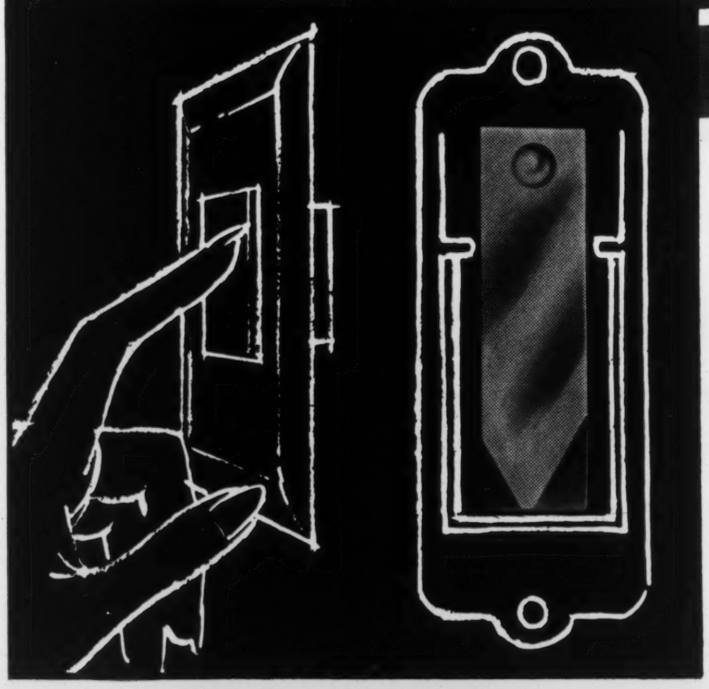
DURAFLEX® makes swivel lamps swivel better

Berger Machine Products of Maspeth, New York, manufacturers of lighting-fixture parts, had a problem with a swivel fixture. To allow adjustment of the reflector, the two steel parts (illustrated) have to rotate 350 degrees. Steel-on-steel froze and locked. A brass ring bushing helped, but being soft allowed the steel to cut in and bind. Berger tried Duraflex, Anaconda's superfine-grain phosphor bronze, and found the answer. Its springiness, hardness and wear-resistance made a snug fit which turned easily and would hold in any position.



FORMBRITE® helps finish phone locks faster

Tele-Lock, an ingenious device for locking a dial phone, is encased in a chromium-plated brass cup. Slaymaker Lock Co., Lancaster, Pa., was using ordinary drawing brass for this cup and found finishing costs high. They turned to Formbrite, Anaconda's superfine-grain forming brass. The cups were easy to form; the slight extra spring and hardness made the fit perfect. The smooth surface of Formbrite eliminated one polishing operation and provided an ideal surface for a lasting chromium plate.



DURAFLEX makes superior contacts for Touch-Plate®

Touch-Plate Mfg. Corp., Long Beach, Calif., makes low-voltage switch systems for control of lighting in the home. It takes only a flick of the finger or elbow on the momentary contact switches to actuate a relay, or set of relays, which turns lights on or off in one room or through the house. For the contact strips in Touch-Plate wall switches they now use Duraflex, Anaconda's superfine-grain phosphor bronze, because they found it has more spring, better recovery properties. Duraflex is now used also for contacts in the relays which operate the Touch-Plate system.

FOR INFORMATION WRITE: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

5767

DURAFLEX

The new superfine-grain phosphor bronze with greater endurance limit.

FORMBRITE

The new superfine-grain drawing brass that cuts finishing costs

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Materials & Methods

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Selection & use of metals, nonmetallics, parts, finishes in product design & manufacture

JUNE 1957 **VOL. 45, NO. 6**

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WILLIAM P. WINSOR
Publisher

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Published monthly by
REINHOLD PUBLISHING CORP.
430 Park Avenue
New York 22, N. Y.

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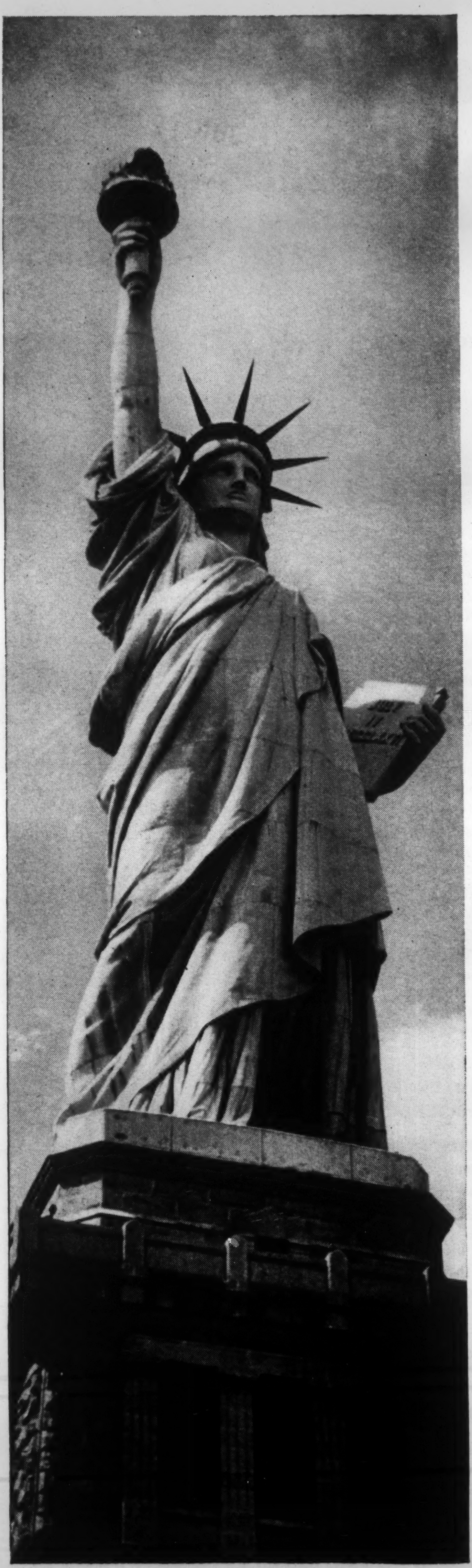

What kept her from falling apart?

The Statue of Liberty was once in danger.

Not from a foreign foe. Not from a crackpot's bomb. This peril was less exciting . . . *but no less destructive.*

It was corrosion — corrosion that had been at work ever since Liberty first raised her torch above the salty waters of New York harbor.

Relentless and merciless in its attack, the acrid, smoggy sea air had loosened and weakened the rivets holding the statue's huge sheet metal plates together. Miss Liberty was dangerously close to falling apart at the seams!

Something had to be done, that was clear. But *what?* Re-riveting wasn't practical. Too many hard-to-get spots in the statue.

This problem was put to an expert — a fastenings manufacturer. His solution: Parker-Kalon® Self-tapping Screws of Monel* nickel-copper alloy. Monel alloy to keep corrosion at arm's length. And self-tapping screws to pull the plates up snug and tight — from *outside* the statue!

So 65,000 self-tapping Monel alloy screws were used to "run up the seams" of Miss Liberty's robes. The job was done in 1938 . . . easily . . . neatly. And from the looks of these corrosion-resisting fastenings today, Miss Liberty's worries are over for a long time.

Do you have a problem in which corrosion is a major factor? Or wear? Or high temperatures? Or some destructive *combination* of conditions? Then look into the Inco Nickel Alloys. Their properties are described in a helpful booklet called *Standard Alloys for Special Problems.* Write for a copy.

*Registered trademark

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INTERNATIONAL NICKEL
Nickel Alloys Perform Better, Longer

For more information, turn to Reader Service Card, Circle No. 549

What's new IN MATERIAL

...AT A GLANCE

A HIGH STRENGTH CERAMIC has been developed that has unusually high mechanical strength and excellent dielectric properties at extremely high temperatures. (More details next month.)

A POLYESTER FIBER SYNTHESIZED FROM LIGNIN has strength properties similar to those of rayon, nylon and Dacron, and has good dyeing properties, very low water absorption and a high melting point. Raw material costs are relatively high at present.

AN ALUMINUM ALLOY WITH SCRATCHPROOF COLOR may soon be available. According to recent reports, a vivid purple-colored aluminum alloy results when certain rare earth metals are alloyed with aluminum. The purple color permeates the metal itself and not merely the oxide layer, making the purple finish 100% scratchproof.

EXTREME HIGH TEMPERATURE TESTING is possible with a "plasma jet" device that produces a temperature of 26,000 F. The fierce heat is produced in a special electric arc and is delivered in the form of a fast jet of highly ionized gas or "plasma." The plasma jet has been used to test refractory materials for supersonic aircraft and missiles.

MAGNET WIRE INSULATED WITH TEFLON is now commercially available for high temperature applications. In addition to the good heat resistance of Teflon, the wire is claimed also to have good electrical stability, low loss factor, low dielectric constant and good dielectric strength. Present applications include motors, generators, converters, transformers, relays and solenoids.

A HIGH DENSITY POLYETHYLENE RESIN exhibits properties particularly suited for the manufacture of polyethylene pipe. According to the producer, the process for making the resin is entirely new and does not resemble either the Zeigler or Phillips process. The polyethylene pipe is claimed to have good resistance to impact, heat, chemicals, organic solvents and hydrocarbon liquids. (More details next month.)

CHROMIUM PLATED ULTRA HIGH STRENGTH STEELS retain their unplated fatigue strengths if the surface is shot peened before plating, recent research shows. Otherwise chromium plating reduces fatigue strengths of ultra high strength steels by as much as 50%.

A SYNTHETIC RUBBER COATING, consisting of styrene-butadiene rubber latex, is designed specifically as a baked industrial finish for metals. The material, a colloidal dispersion of resin in a water system, is nonflammable and nontoxic. According to the producer, greater film thickness per coating is possible with the new coating, since it has a higher solids content than conventional rubber-base coatings.

A NEW SILICONE RUBBER COATING meets Navy specifications for silicone rubber-coated glass tapes and is said to be completely resistant to reversion. The silicone rubber coating is recommended for use on glass sleevings, electrical components, hot air ducts and hoses. (More details next month.)

SMALL BORON ADDITIONS give certain high temperature alloys tensile strength values 25% higher than those of conventional high temperature alloys.

TITANIUM BELLOWS are being used in aircraft ductwork to allow for greater degree of expansion and contraction in these ducts. Titanium was chosen because it cuts the weight of these parts by 44% when substituted for stainless steel. The bellows operate at pressures from 50 to 400 psi.

A NEW REFRACTORY CEMENT that bonds metal, glass and ceramics to metal withstands service temperatures of -420 to 1000 F. The cement remains slightly malleable after drying and does not crack, craze or check when used on a constantly flexing surface. It is recommended for attaching transducers, gages and lead wires to the skins of guided missiles.

UNIFORMITY OF AN ALLOY may vary with temperature changes, recent tests indicate. When heat was applied to a lead-tin alloy containing 14.8% tin, the percentage of tin reached a maximum concentration of 15.7% near the hot end and a minimum of 13.8% near the cold end.

MOLECULAR ALPHA IRON CRYSTALS, so small that a billion of them occupy less space than a grain of table salt, are reported to greatly increase the strength of nonmetallic materials. The small crystals behave not as metals or fillers, but as chemicals. They combine with nonmetallic substances such as natural and synthetic rubber and plastics to form molecular cross-linkages.

MATERIALS BRIEFS

Bubbles Break Ice

Forced air bubbles rising from pinprick holes in plastics tubing laid on the bottom of a fresh water lake help keep the lake ice-free in winter. The air bubbles raise warm layers of water from the bottom of the lake and melt the ice on top.

Hold That Line

A steel blocking sled is being used instead of a wooden sled to train and condition football linemen. Four-in.-thick pads and 8-in. springs resist the shock of the onrushing linemen.

Modern Beau Brummel

A chemical compound called "methylolcyclicethyleneurea" is claimed to put a permanent crease in wrinkle resistant cotton cloth used in men's clothing.

Just Breezin' Along

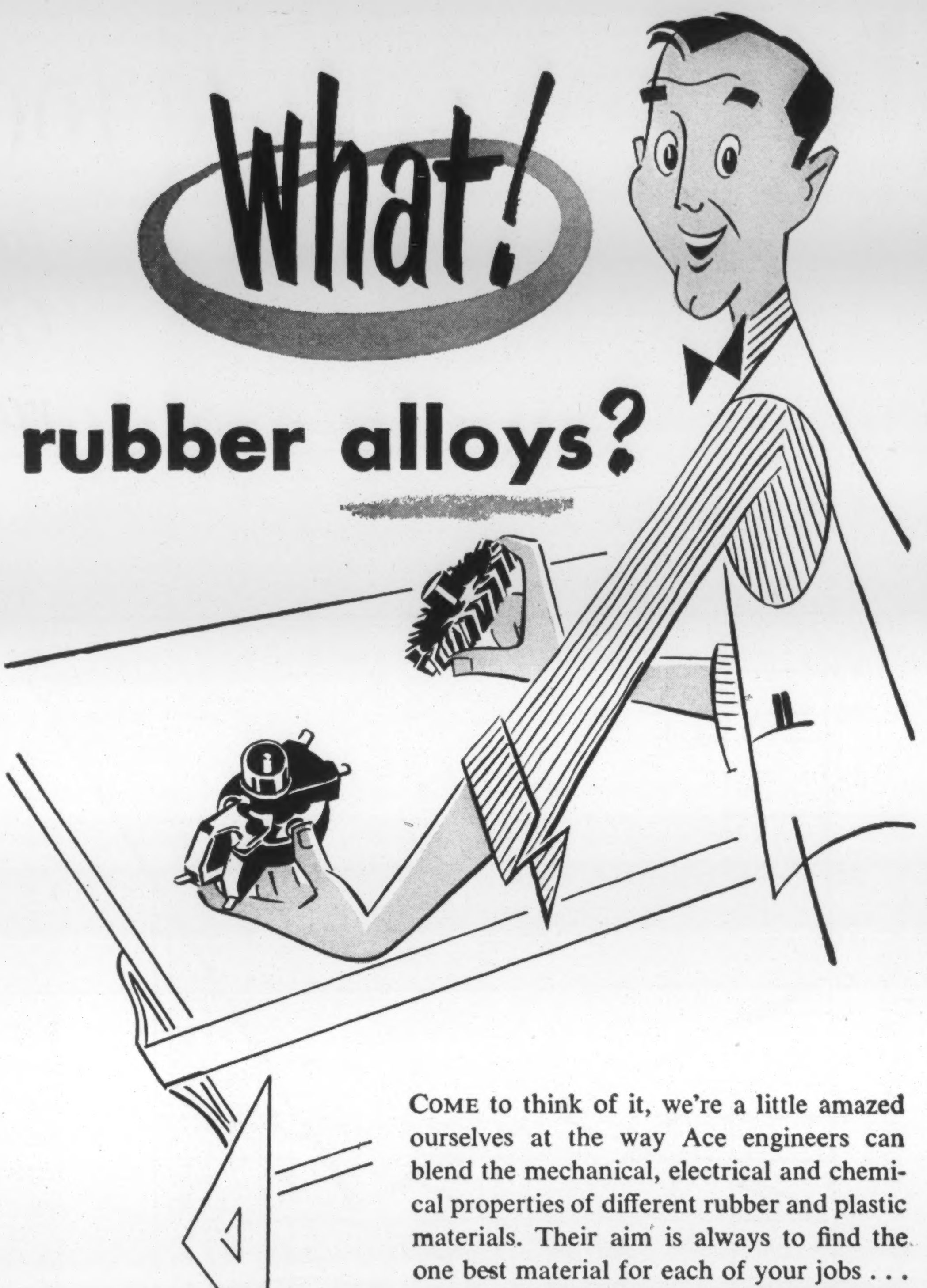
A jet powered car, capable of speeds over 200 mph, is being used by the Navy to test the strength of landing gears used on jet planes. Powered by four jet engines, the car can attain the speed of a landing jet plane yet push a load comparable to the weight of a twin-engine bomber.

Much Titanium

Over 10,000 lb of titanium are being used in the construction of the Navaho missile. About 43% of this titanium is in the form of 0.060 in. thick sheets.

Cottage in the Sky

Plastics houses may some day be constructed from a helicopter hovering over a building site. Walls and foundations of plastics will be poured through hoses from aircraft fitted with cement mixing equipment.


What!
rubber alloys?

COME to think of it, we're a little amazed ourselves at the way Ace engineers can blend the mechanical, electrical and chemical properties of different rubber and plastic materials. Their aim is always to find the one best material for each of your jobs . . . never *over*designed . . . with production economy a must. Result: hundreds of tailor-made rubber, plastic, and rubber-plastic alloys to choose from . . . plus many unusual materials like Ace-Tex pyrobitumens. Ask us for anything from rough-ground rods to finished molded assemblies. Our facilities for molding, extruding, fabricating, and lining are among the world's largest.

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ELECTRICAL,

CHEMICAL APPLICATIONS

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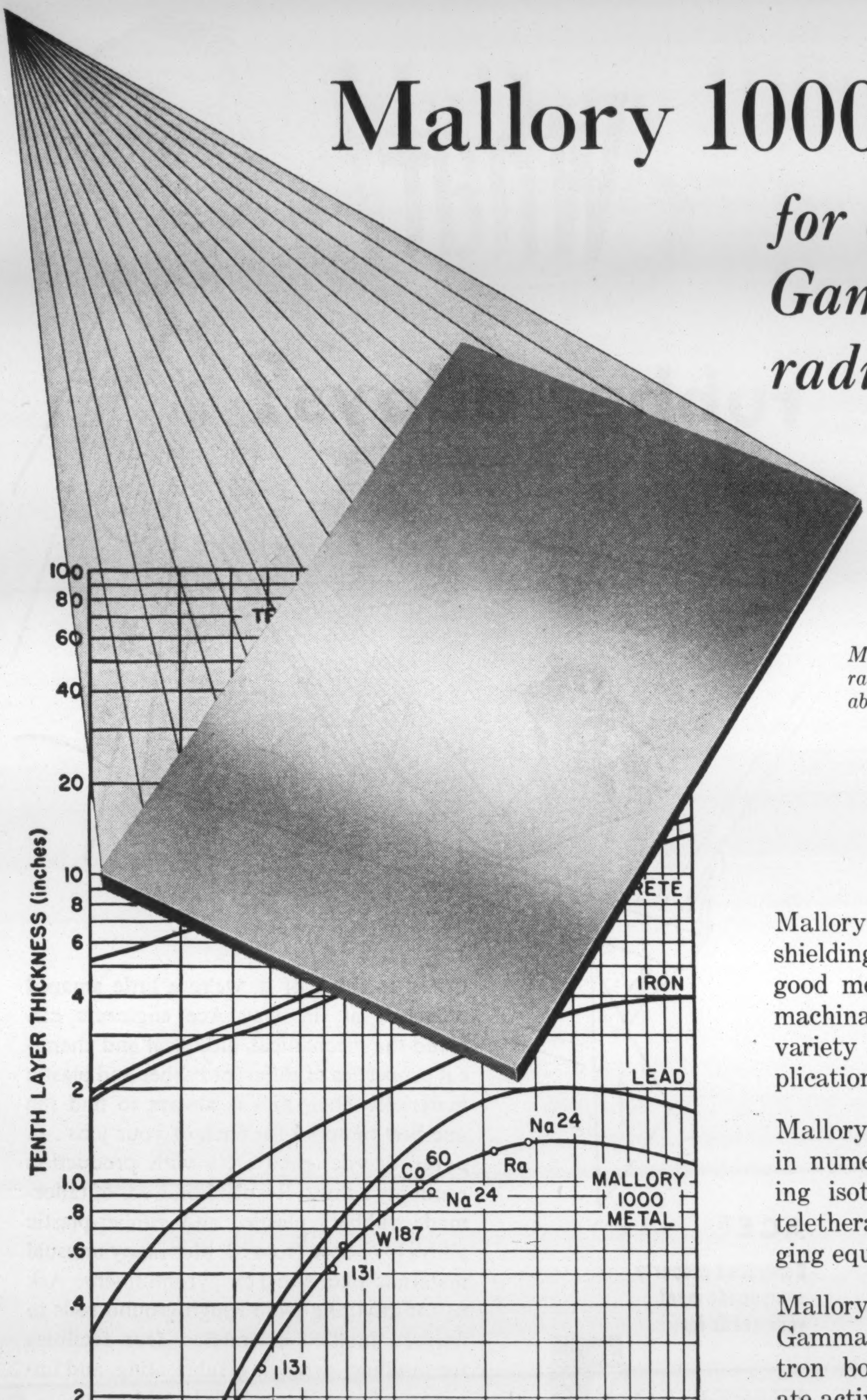
Mallory 1000 Metal

for effective Gamma radiation shielding



Gamma absorption characteristics.

Mallory 1000 "slab" for radiation shielding available in sizes up to 6" x 15".

Mallory 1000 Metal is ideal for radiation shielding applications. It has high density, good mechanical strength, and excellent machinability . . . is available in a wide variety of shapes and sizes for many applications in this field.

Mallory 1000 Metal is already being used in numerous applications such as shielding isotope shipping containers, cobalt teletherapy machines, and oil well logging equipment.

Mallory 1000 Metal effectively absorbs Gamma radiation . . . low intensity neutron bombardment causes only moderate activity.

If you have radiation shielding problems, it may pay you to investigate Mallory 1000. Write for your copy of Technical Bulletin 6-7C.

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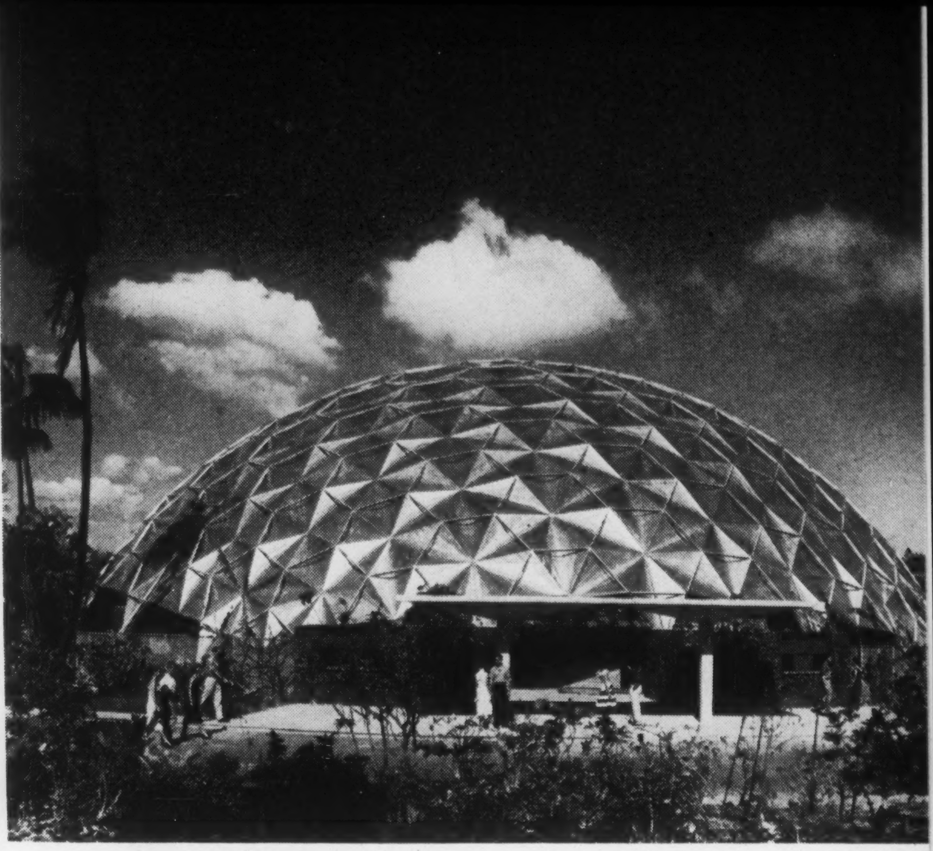
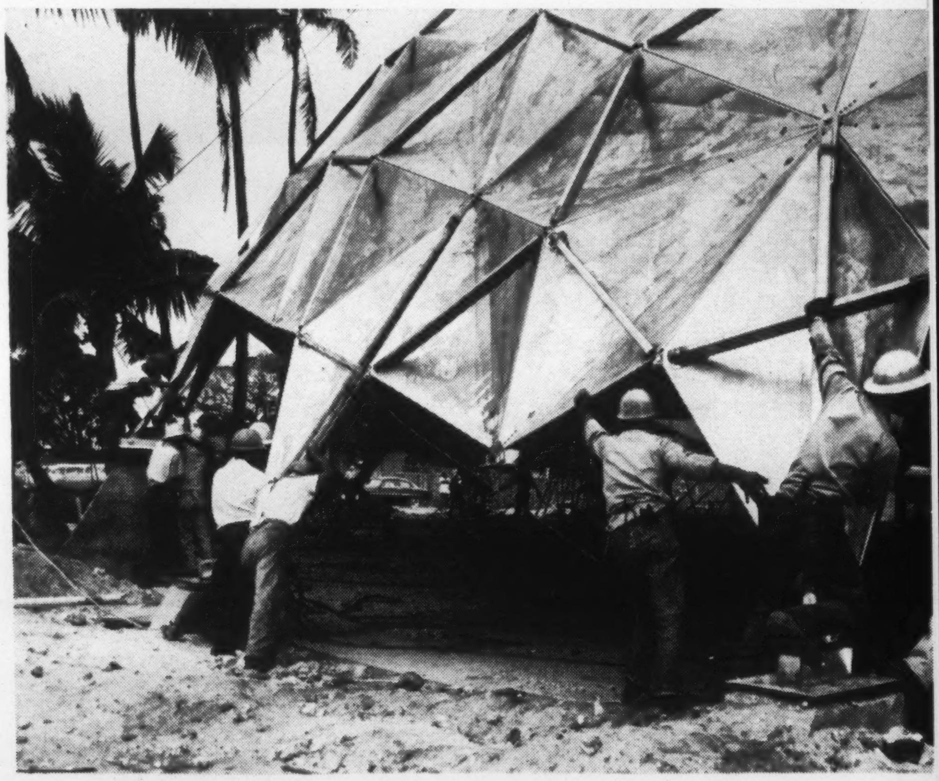
MATERIALS AT WORK

New and interesting applications of engineering materials



***Aluminum-domed auditorium** is erected by aligning . . .*



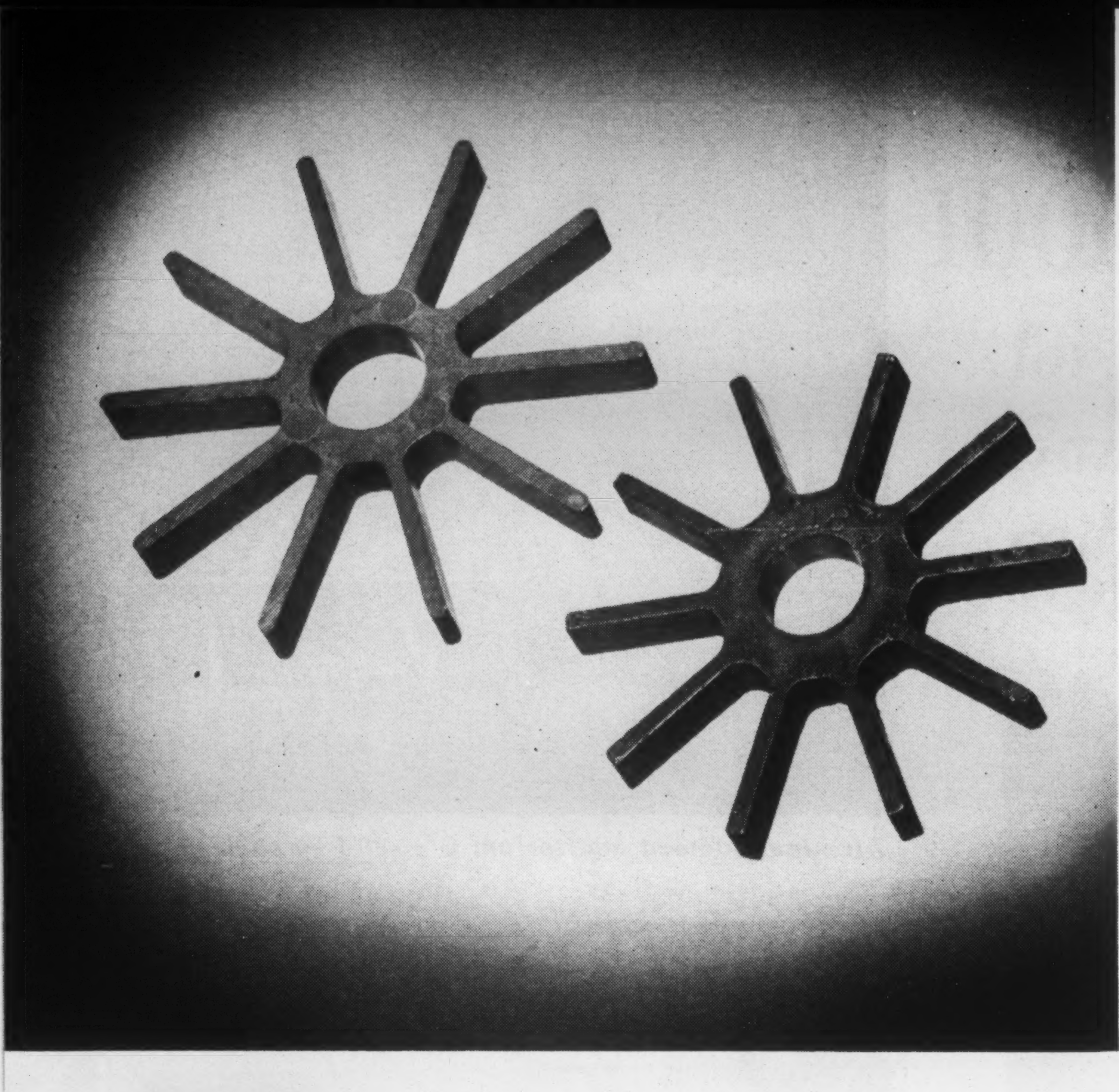
*. . . **aluminum panels** and struts and bolting in place.*

Prefabricated aluminum is tops for auditorium

The aluminum-domed auditorium shown here is 49½ ft high, 145 ft in dia, and seats about 2000 people—yet it took only 20 hr to erect.

Designed and fabricated by Kaiser Aluminum & Chemical Corp., the dome consists of 575 aluminum panels and struts. The panels, which are diamond-shaped and vary in length from 9 to 11½ ft, are geometrically arranged and bolted together at their edges to form a rigid shell. Each panel is curved inward and strengthened with the struts.

In addition to speed of erection, high strength (the aluminum dome withstands loads of more than 100 psi) and light weight (39,000 lb), the aluminum dome construction offers the advantage of extra space, since the dome requires no interior pillars or other supports.



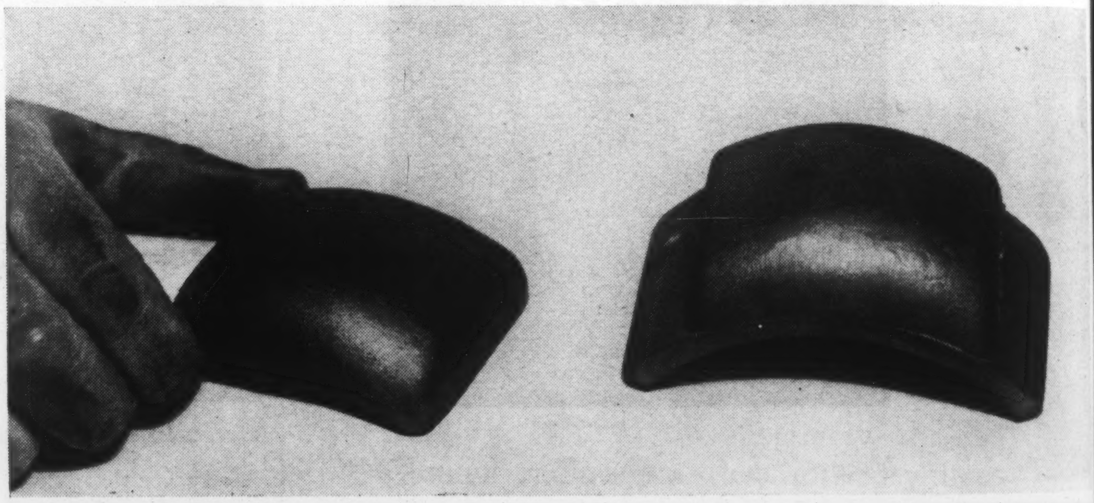
Die cast zinc replaces sand cast aluminum

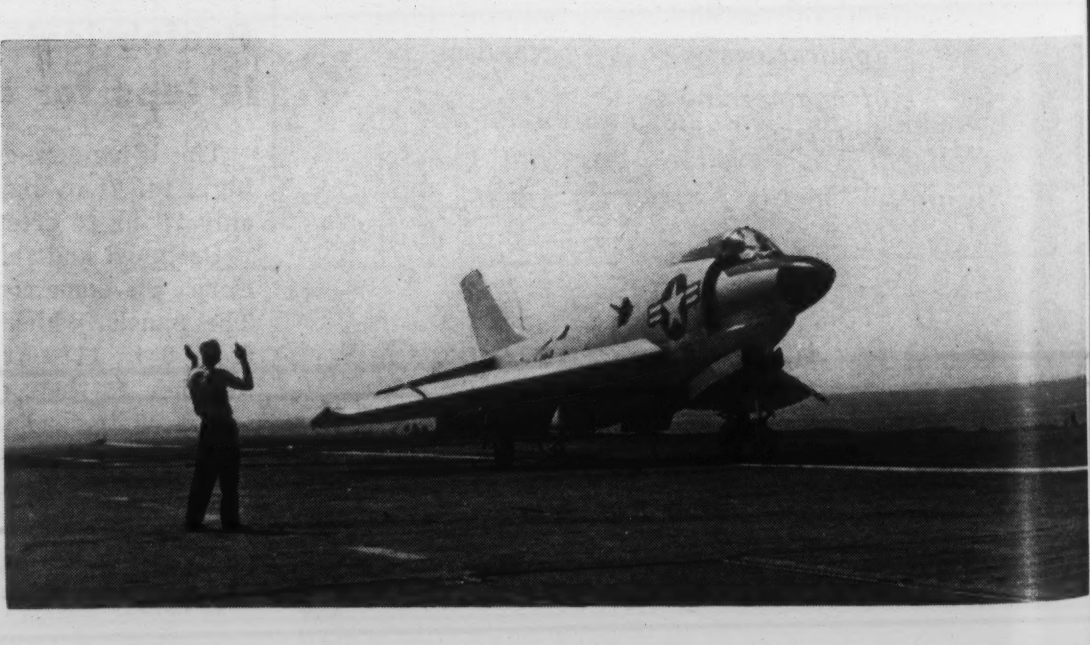
By switching from an aluminum sand casting to a zinc die casting, Baldor Electric Co. has reduced material and labor costs on its motor fans by as much as 61%.

The aluminum sand castings previously used were often irregular and unbalanced, and required expensive finishing and machining operations. The zinc fans, die cast by A. B. Mueller Co., require no finishing operations, and most secondary operations have been eliminated. The only operations necessary to complete the zinc die cast fans are trimming and tapping the cored set screw hole. The shaft hole diameter of the fan is held within ±0.0005 in. as cast.

Zinc die cast fan *(left) is smoother, better balanced and less expensive to produce than aluminum sand cast fan (right).*

MATERIALS
AT WORK





Iron alloy + steel plate = tough tail skid for jets

Aircraft tail skid assemblies composed of an iron-base alloy casting (above left) brazed to a curved steel plate (above right) are being used on the McDonnell Demon Navy jet fighters (below).

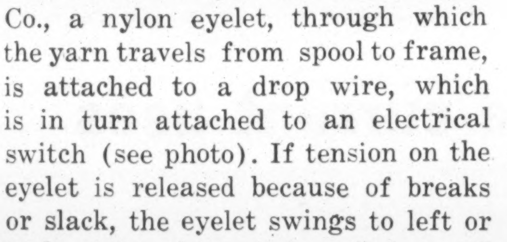
The skids, supplied by Wall Colmonoy Corp., have a coefficient of friction low enough to prevent damage to the wooden deck of aircraft carriers, yet have excellent resistance to abrasion, impact and corrosion.

Extruded polystyrene replaces machined fibre

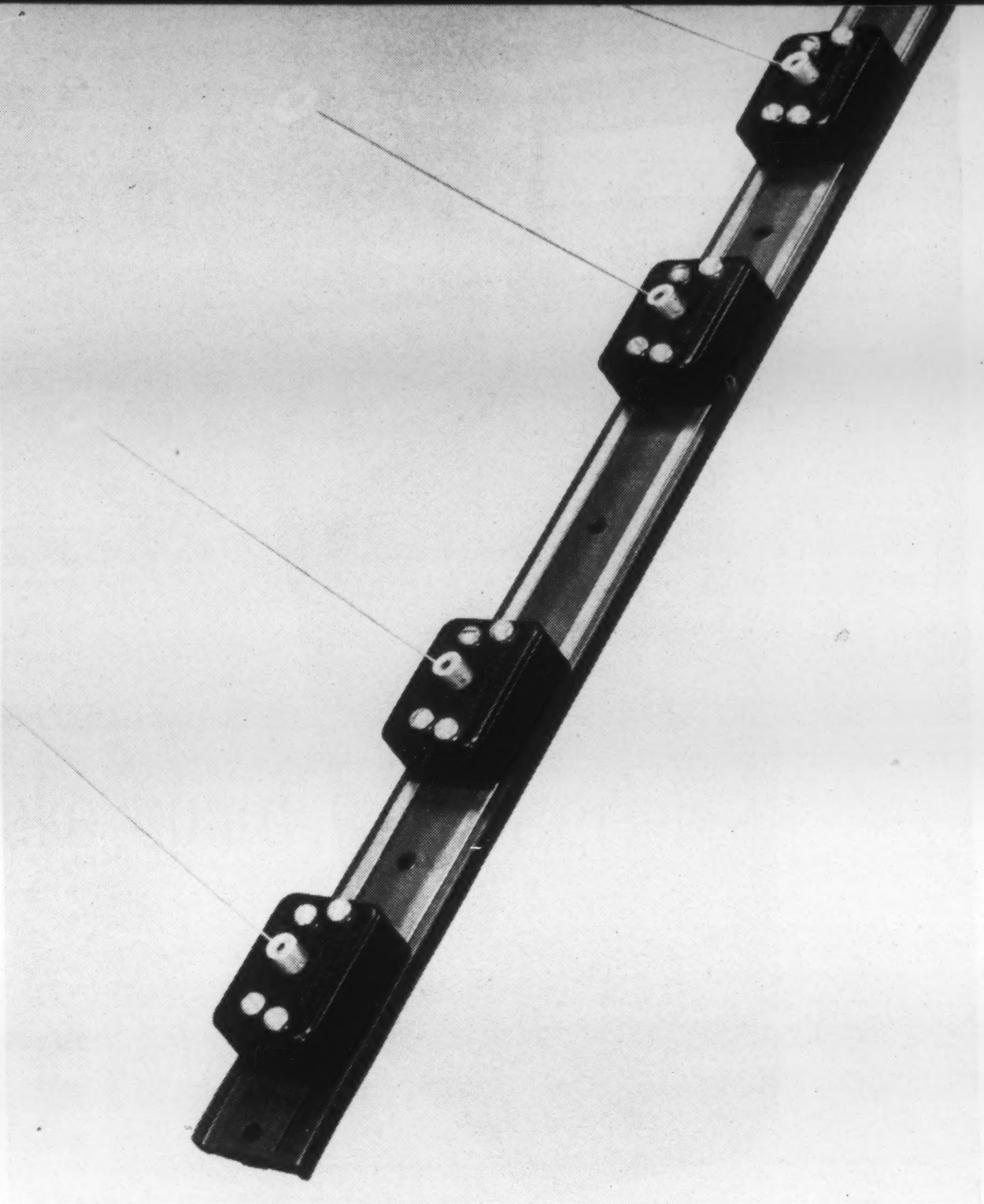
The change from machined vulcanized fibre to extruded high impact polystyrene for a switch mounting strip has resulted in easier installation, elimination of warpage and a cost saving of at least 50%.

The strip is used in a device that turns off a spinning machine before damage can be done as a result of slack or breaks in the yarn. In this device, known as Adamstop and manufactured by Steel Heddle Mfg. Co., a nylon eyelet, through which the yarn travels from spool to frame, is attached to a drop wire, which is in turn attached to an electrical switch (see photo). If tension on the eyelet is released because of breaks or slack, the eyelet swings to left or right, trips the switch and shuts off the machine.

The vulcanized fibre mounting strip previously used was costly and required an expensive operation of saw-cutting grooves for copper conducting strips. In addition, it was subject to warpage and often caused misalignment of the switch. The polystyrene strip is extruded by Anchor Plastics Co. with two upper grooves into which the copper strips are inserted. No machining or other secondary operations are required. Two wide grooves on the bottom of the strip serve to reduce weight and material cost.

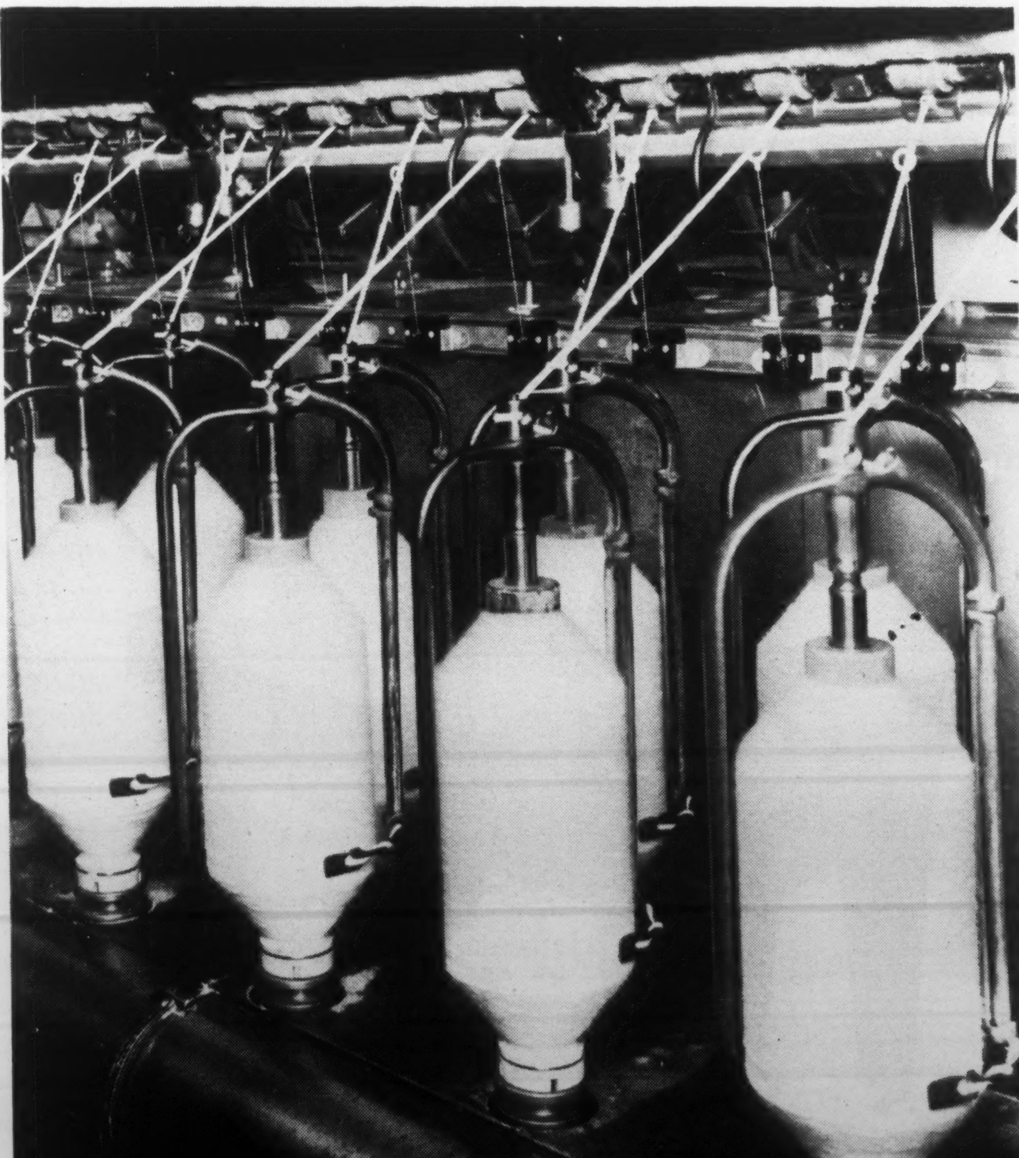


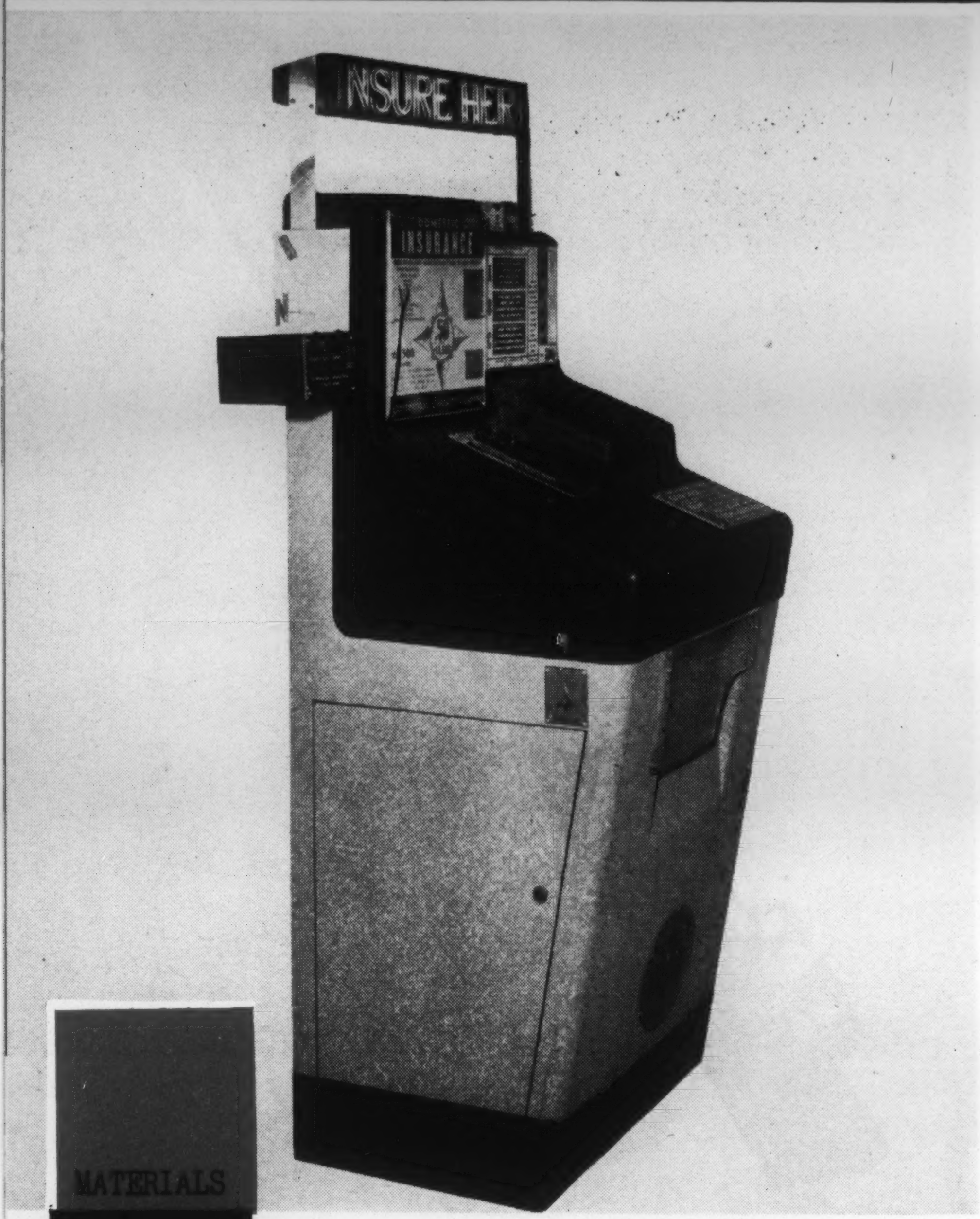
Old and new designs.



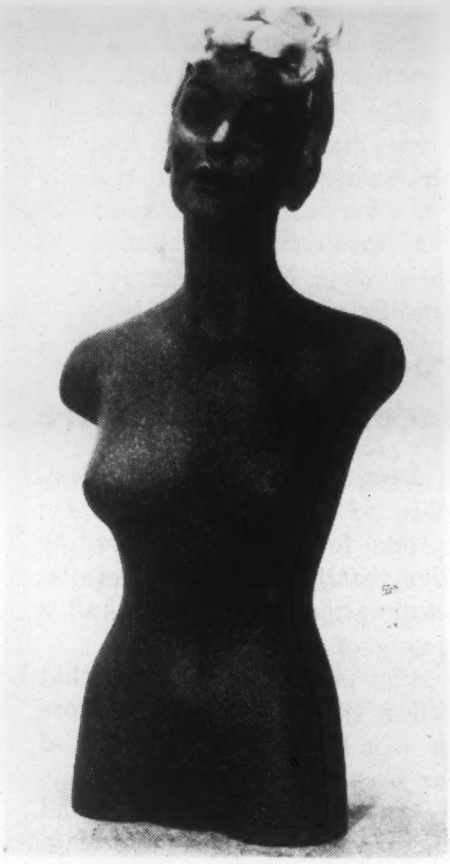
Extruded mounting strip *holds switches that stop the . . .*

. . . spinning machine *when slack or breaks in the yarn occur.*



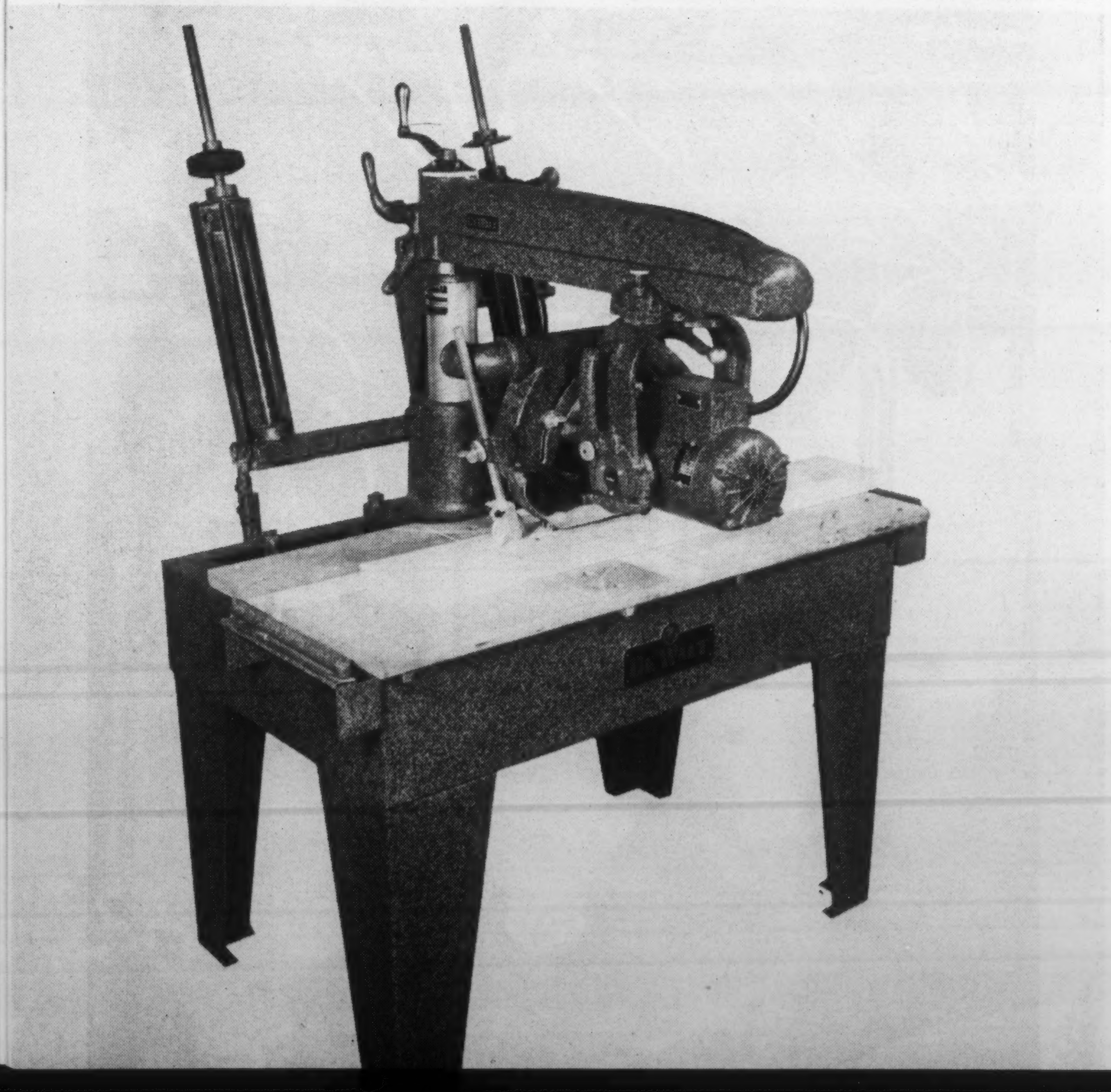


Paramount Paint & Lacquer Co.



Paramount Paint & Lacquer Co.

Multicolor lacquers: some current uses



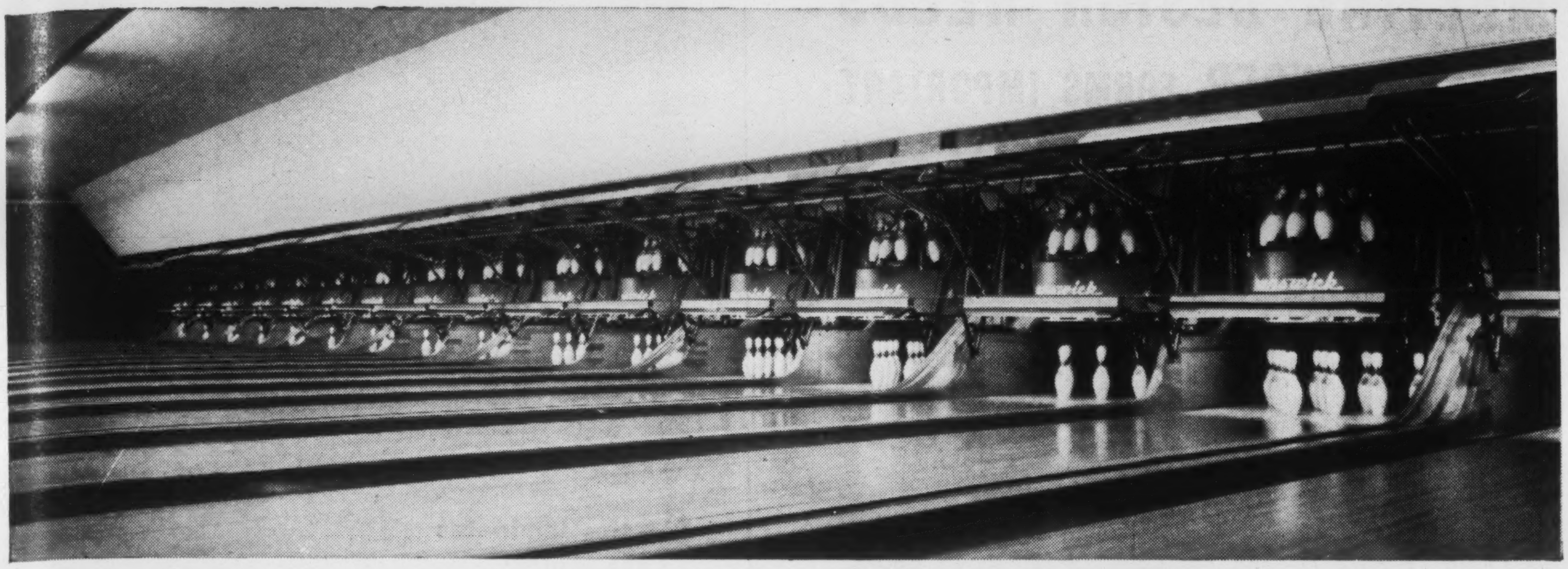
Maas & Waldstein Co.

These photos show some of the products currently finished with multicolor lacquers—a material that has been commercially available only a few years and was first used primarily for architectural purposes.

Multicolor lacquers provide a mat finish flecked with as many as five colors, all of which are applied in one spraying operation. These finishes (see M&M, Nov '54, p 86) consist of cellulose lacquers suspended in water and stabilized to prevent blending of the different colored particles. The particles remain separate during application and drying, and they are large enough to form a distinct color pattern. Many different particle shapes are possible.

The resulting coating is nonstatic, washable and resistant to oils, grease, lubricants, gasoline and grime; it can be sprayed on 5 to 6 times as thick as conventional paint; and it is tough and has extremely high abrasion resistance.

'Brunswick finds RCI resin right down its alley!"



Tough, durable rake board for pinsetter made with

RCI POLYLITE

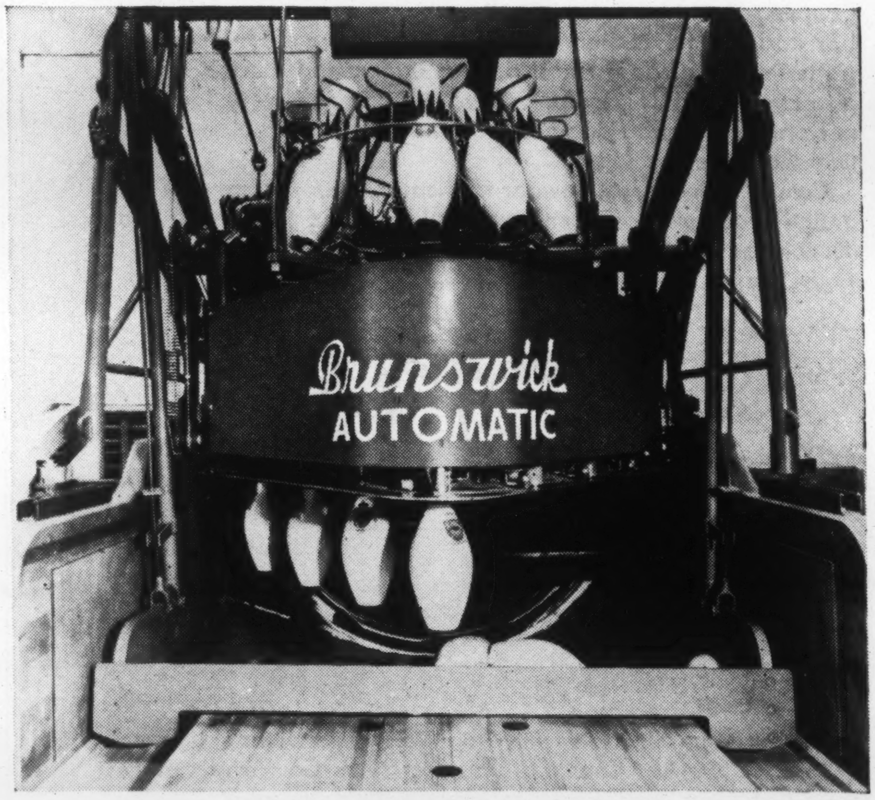
• The automatic pinsetter you see here increases the efficient operation of bowling alleys all over the country. Adds also to the fun and precision of the sport.

In designing this pinsetter, The Brunswick-Balke-Collender Company of Chicago needed a material with special properties for the rake board which clears the "deadwood" from the alley. The board had to be *light, smooth surfaced, tough and wear-resistant.*

Engineers at Brunswick experimented with RCI POLYLITE polyester resin and fibrous glass. They found they could produce a rake board with all the desired qualities by combining POLYLITE, glass fibre mat and outer layers of glass cloth to provide the smooth, wear-resisting surface.

"The most important reasons for our selection of Reichhold's Polyester Resin," say the Brunswick engineers, "were the requirements in this application of exceptional toughness and wear resistance."

Perhaps the combination of light-weight strength, durability and smooth colorful surfaces you get with RCI POLYLITE and fibrous glass construction can be incorporated into one of your products. Why not find out more about what *you* can do with RCI POLYLITE for laminating, molding and other applications? Write to Reichhold for *Booklet A.*



From large sheets of reinforced POLYLITE Brunswick cuts rake boards for its new automatic pinsetter. This close-up photo shows the light, wear-resisting rake board in action removing "deadwood."

Creative Chemistry . . . Your Partner in Progress RCI

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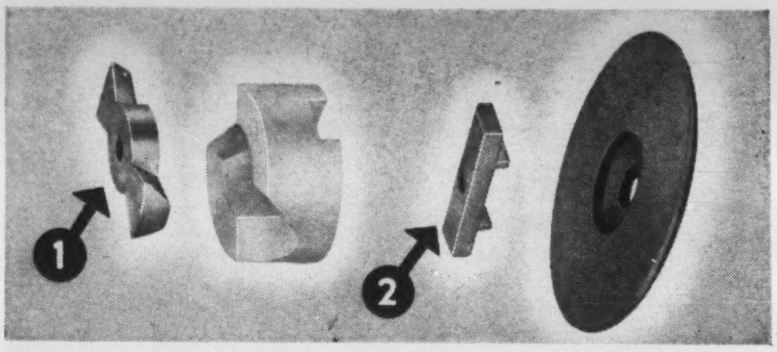
Synthetic Resins • Chemical Colors • Industrial Adhesives
Plasticizers • Phenol • Formaldehyde • Glycerine • Phthalic Anhydride
Maleic Anhydride • Sebacic Acid • Sodium Sulfite • Pentaerythritol
Pentachlorophenol • Sulfuric Acid

REICHHOLD CHEMICALS, INC.,
RCI BUILDING, WHITE PLAINS, N. Y.

For more information, turn to Reader Service Card, Circle No. 517

MEETING DESIGN NEEDS
BRASS POWDER FORMS IMPORTANT CONNECTION FOR WESTERN ELECTRIC

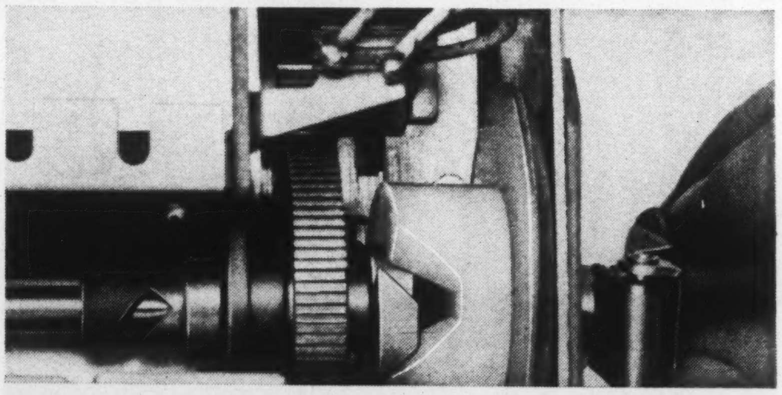


The Clutch Coupling (1) and Bar Coupling (2), shown above, function with two insulators to form an important drive linkage in Western Electric's "lineman's test set". These BRASS POWDER parts perform the dual role of activating a signaling generator and retaining a molded nylon cam that insulates the handle up to 10,000 volts.

The complex, curved surfaces on the blades of the Clutch Coupling would be very difficult and expensive to machine from bar stock. For this reason, Western Electric designed both of these parts for the powder metal process and turned the job over to an experienced fabricator*. Thus, unit cost was very low, high performance standards were met and much valuable machining time was saved.

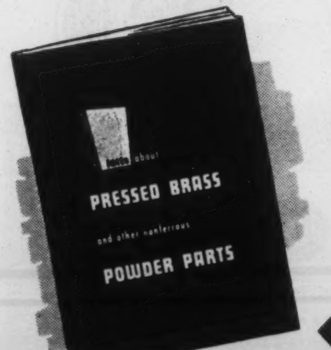
Consult with a metal powder fabricator when you have difficult design problems—or when you simply want to lower your production costs with BRASS POWDER sinterings.

*Parker White-Metal Company, Erie, Pa.



Detail of the Clutch Assembly on Western Electric's signaling generator. The Bar Coupling turns the Nylon Cam which pushes the Clutch Coupling forward to engage the drive gear.

How Can BRASS AND NICKEL SILVER POWDER PARTS Meet Your Design Needs?



For detailed information on the design, properties, production and application of brass and other nonferrous powder parts you should have a copy of our manual. It will give you 20 case histories of brass and nickel silver powder structural parts to assist in evaluating this means of production in terms of your particular needs.

◀ SEND FOR YOUR COPY

THE NEW JERSEY ZINC COMPANY
160 Front Street New York 38, N. Y.

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M&M LETTERS NEW YORK
Letters
to the Editor

Plastics laminates

To the Editor:

Our compliments on the wonderful manual in your February issue entitled, "Selecting Plastics Laminates for Industrial Use." We think you have done a wonderful job for our industry and have covered the subject very well . . .

HERBERT WIDDOP
Synthane Corp.
Oaks, Pa.

To the Editor:

. . . excellent article . . . while digging for reference material would certainly have appreciated such a fine round-up article . . .

ROBERT J. BARRUS
Bakelite Co.
New York, N. Y.

Trade name confusion

To the Editor:

I notice that your Oct '56 issue carried on page 141 a data sheet on cobalt alloys in which the word "Vitallium" was used as being synonymous with Haynes Stellite 21.

"Vitallium" is a registered trademark of Austenal, Inc., and is therefore not descriptive of any one material or class of materials. We apply this trademark only to certain of our dental and surgical products, so any use of the term in connection with an industrial metal is totally incorrect.

As you can understand, it is very important to the preservation of our trademark rights that we correct any misimpression of this kind, and we shall appreciate your confirmation on this point.

CHARLES A. CERAMI
Manager of Legal Activities
Austenal, Inc.
New York, N. Y.

Hot forged parts

To the Editor:

The manual on "Hot Forged Parts" in the March issue is a fine piece of accurate writing. We wish to extend our compliments . . .

DWIGHT M. ALLGOOD
Executive Vice President
Drop Forging Assn.
Lansing, Mich.

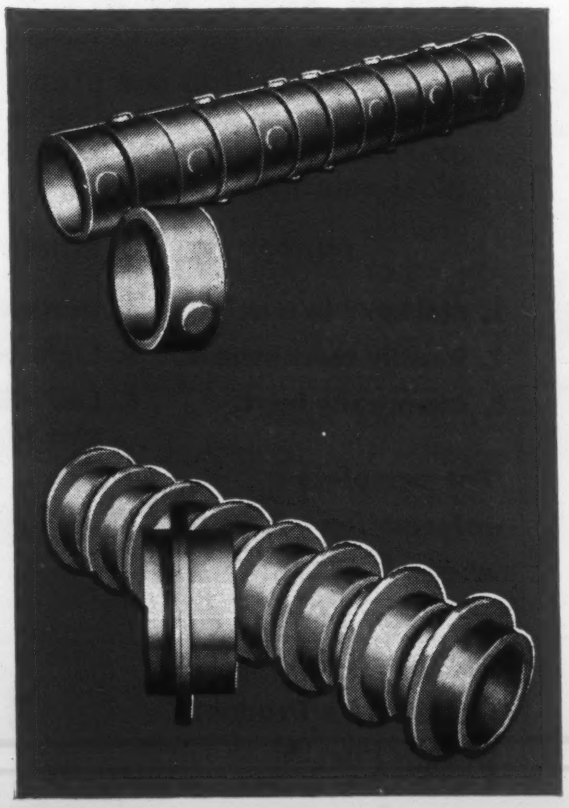
Button, button

To the Editor:

According to "Materials Briefs" on page 7 of your Feb '57 issue, approximately 12 million pounds

HOW MUCH A POUND DID YOU PAY FOR THE HOLE?

NOT ONLY FOR THE METAL ALONE BUT ALSO IN UNNECESSARY MACHINING TO MAKE THE PART YOU NEED



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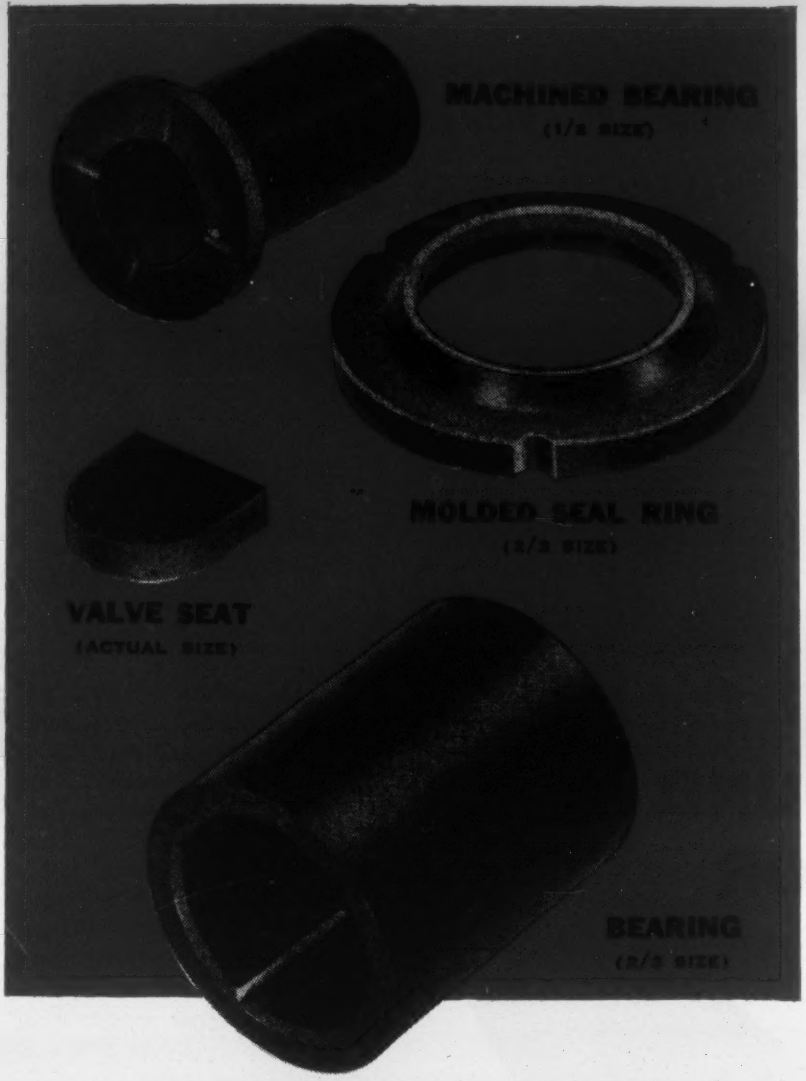

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4. Dimensionally stable.
5. Light weight.
6. Low cost where moldable to size.

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Letters to the editor

of polyester resin are used annually in making shirt buttons.

This seems fantastically high to me since I was under the impression that melamine and urea constituted the bulk of this market. This 12 million pound figure for polyester would argue with a great many figures I have seen regarding end uses for this resin.

I would appreciate confirmation or correction of this figure.

THOMAS H. WILSON
Marketing Research Dept.
General Tire & Rubber Co.
Akron 9, Ohio

Due principally to the tight competition in the button industry, it has been extremely difficult to obtain accurate figures. We do retract our original estimate, however; we believe that from four to six million pounds of polyester resin are used annually for buttons. Factual comment on this estimate would be welcomed.

They love us in Kansas

To the Editor:

Your selection of subjects in M&M has been excellent. I am a tool and die maker and your publication has helped me, and those working with me, to keep informed about new trends and materials.

A large part of our work is on pre-engineered products, such as aircraft. Questions have come up and I have written M&M for advice. Your cooperation has been wonderful and very helpful.

One question I asked several years ago led you to refer me to a text which has been in almost weekly use since I bought it. I can't say how much time and money it has saved in tool design, reworking of tooling and product design.

I have taken M&M for quite a spell. I do not have the first copy due to space limitations but I do have tear sheets from all issues . . .

FORD S. VAN VLEET
Wichita, Kan.

Much too strong

To the Editor:

We appreciate the piece entitled "Epoxy Potting Resin for Electrical Parts," which concerns our new resin. This was published on page 194 of your Apr '57 issue. It does, however, contain a typographical error which we believe should be corrected. The tensile strength is erroneously stated as 12,000 psi. The correct figure is 1200 psi.

JOHN DELMONTE
General Manager
Furane Plastics, Inc.
Los Angeles

An announcement

Materials & Methods to change its name to

Materials in Design Engineering

—A new name but the same magazine

After nearly two years of intensive study and research we have decided to rename MATERIALS & METHODS. To more accurately indicate our editorial scope we will adopt the name MATERIALS IN DESIGN ENGINEERING beginning next month.

The decision to change the name was not an easy one for us to make. And it was made only after we consulted with many of our readers and advertisers, and after a thorough and far reaching investigation was made by James M. Vicary Co., an independent research organization.

Why a new name

Over the past ten years our magazine has developed into a publication that now devotes all of its editorial space to information on engineering materials—their selection and application in industrial and consumer products. Likewise, most of the advertising pages in the magazine are now providing information about the materials, material forms and finishes used in the design and manufacture of engineered products.

Our experience and the research has shown that the name MATERIALS & METHODS does not reflect this now firmly established editorial program. It is too broad and subject to many different interpretations. The word "methods" has been a source of constant confusion that has led to some misunderstanding of our field of coverage. To many people, the word "methods" implies production techniques and tooling. To others it means materials handling. And to still others it means systems analysis, or time and motion studies. None of these subjects falls within our editorial scope. These and other misleading connotations of the name convinced us we should seek a more accurate and descriptive title.

You prefer the new name

If you were to start a magazine today with the editorial objectives briefly outlined above what would you name it? Research to find the answer to this question conclusively showed that most of you would prefer the name we have selected—MATERIALS IN DESIGN ENGINEERING. It is completely appropriate to the editorial field and function of the magazine. First, the word MATERIALS was retained because it is descriptive of the magazine's editorial and advertising content which encompasses the basic engineering materials and their forms, as well as finishes and coatings. And second, IN DESIGN ENGINEERING was added to clearly establish that we are *the* materials magazine of the design engineering field, and that we cover the materials selection function in this field.

A change in name only

We hope you will agree with us that the new name is more appropriate and will eliminate the confusions inherent in the former title. Above all we ask you to remember that this is a change in name only. Our editorial aims, scope and treatment remain the same as you have known them for many years. We will continue to be the only magazine devoted exclusively to helping all those who select and specify engineering materials for industrial and consumer products. Although "methods" will no longer be in our name, we will continue, as we have in the past, to cover all factors important to materials selection, including methods which alter or affect the properties of materials.

We would like to take this opportunity to thank all the readers and advertisers who willingly gave us their time, ideas and advice to help us make this important decision.

William P. Winsor
Publisher
H. R. Clauser
Editor

ORGANIC FINISHES SELECTOR CHART

ORGANIC COATING →	Alkyd	Alkyd-Amine	Alkyd-Urea-Formaldehyde	Styrenated Alkyd	Alkyd-Phenolic	Alkyd-Silicone	Phenolic	Silicone	Epoxy-Amine	Epoxy-Urea
PERFORMANCE REQUIREMENTS										
Exterior Durability	E	E	E	E	E	E	E	E	E	E
Salt Spray Resistance	E	VG	G	G	E	E	E	E	VG	VG
Chemical Resistance										
Water	F	G	F	G	E	E	E	E	G	G
Acids	P	F	F	G	G	P	VG	P	VG	VG
Alkalies	G	G	G	VG	F	F	F	F	E	E
Solvents	P	G	G	VG	VG	P	E	P	E	E
Foods and Beverages[b]	F	G	G	VG	VG	P	E	P	E	E
Toxicity[c]	None	Slight	Slight	Slight	None	Slight	None	Slight	Slight	Slight
Adhesion to:										
Ferrous Metals	E	E	E	E	E	G	E	G	E	E
Nonferrous Metals	F	E	VG	E	E	F	E	G	E	E
Abrasion Resistance	F	VG	VG	VG	VG	F	E	F	E	E
Hardness	G	E	E	E	E	G	E	G	E	E
Flexibility	E	VG	VG	G	G	F	G	F	G	VG
Impact Resistance	VG	E	E	G	G	G	G	G	G	G
Heat Resistance[d]	G	VG	VG	G	G	VG	G	E	VG	VG
Dielectric Properties	G	G	G	G	VG	E	E	E	VG	VG
DECORATIVE REQUIREMENTS										
Choice of Colors[c]	U	U	U	U	SL	U	L	U	SL	SL
Color Retention[f]	G	VG	VG	G	P	E	P	E	G	G
Initial Gloss	E	E	E	E	VG	E	VG	E	VG	VG
Gloss Retention	E	G	F	G	F	E	F	E	F	F
COST REQUIREMENTS										
% Solids as Supplied[g]	60	60	60	55	60	50	50	50	60	60
Solvents Required[h]	Hyd	Hyd	Hyd	Hyd	Hyd	Hyd	Alc	Hyd	Blend	Blend
% Solids at Spray Viscosity[g]	48	48	48	45	48	40	40	40	60	60
Primer Required for Adhesion	Yes	No	No	No	No	Yes	No	Yes	No	No
Application Methods[e]	U	U	U	U	U	U	U	U	L	L
Cure[i]	A or B	B	B	A or B	A or B	A or B	A or B	A or B	A	B
Coating Thickness, mil[g]	1.5	1.5	1.5	1.5	1.5	1.0	1.5	1.0	1.8	1.8
Coverage, sq ft/gal[g]	450	450	450	400	450	350	350	350	500	500
Cost, ¢/sq ft/mil dry[j]	1.50	1.75	1.50	1.75	1.50	3.00	1.75	6.00	2.00	2.00

Which Organic Coating?

by Howard R. Rothenberg,
J. Landau Co.

In many applications the success or failure of a product is determined by its organic coating. All too often, however, organic coatings are chosen in a haphazard fashion. This article provides a quick, working guide that will help you to select the best coating or group of coatings for your product.

Epoxy-Melamine	Epoxy-Phenolic	Epoxy Ester	Vinyl	Chlorinated Rubber	Fluoro-Carbon	Acrylic	Nitro-Cellulose	Butyrate
E	E	E	E	E	E	E	E	E
VG	VG	E	E	E	E	E	E	E
G	E	VG	E	E	E	VG	F	F
VG	E	VG	E	VG	E	G	G	G
E	E	VG	E	VG	E	G	F	G
E	E	VG	E	G	E	VG	P	G
E	E	VG	E	G	E	VG	P	G
Slight	Slight	Slight	None	Slight	Slight	None	None	None
E	E	E	P	F	E	VG	VG	VG
E	E	E	P	F	E	VG	G	G
E	E	E	E	E	E	VG	VG	VG
E	E	E	G	G	E	G	VG	VG
VG	VG	G	E	P	G	E	E	E
G	G	E	E	G	E	E	E	E
VG	VG	G	P	P	E	P	P	P
VG	VG	VG	E	E	E	VG	P	G
SL	L	SL	U	U	L	U	U	U
G	P	E	VG	G	G	E	E	E
VG	VG	E	G	E	F	E	E	E
F	F	G	F	F	F	E	VG	E
60	60	60	35	45	50	50	40	35
Blend	Blend	Hyd	Blend	Hyd	Blend	Blend	Blend	Blend
60	60	48	25	35	25	40	25	25
No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
L	L	U	L	U	L	U	U	U
B	B	A or B	A or B	A or B	B	A	A	A
1.8	1.8	1.5	1.0	1.5	1.0	1.0	1.0	1.0
500	500	450	200	300	200	350	200	200
2.00	2.00	1.75	2.50	1.50	15.00	2.75	2.50	2.75

NOTES:

[a] E = Excellent; VG = Very good; G = Good; F = Fair; and P = Poor.

[b] Roughly equivalent to weak organic acids.

[c] Refers to use for toys and food container linings.

[d] In general, E = 700-1000 F; VG = 350-700 F; G = 200-350 F; and P = below 200 F.

[e] L = Limited and denotes a poor white cannot be formulated; SL = Slightly limited and denotes difficulty in formulating whites and pastels; U = Unlimited and denotes that any color can be formulated.

[f] Based on white coatings with titanium dioxide pigment.

[g] Variations possible are unlimited; figures given are average values.

[h] Hyd = hydrocarbons. Alc = Alcohols.

[i] A means can be air dried; B means can be baked. In general, any coating that can be air dried or baked will have greater performance characteristics if baked. Baking times and temperatures vary with individual coatings, ranging from 15 min at 300 F for the alkyds to 2 hr at 500 F for the silicones.

[j] Based on high quality formulations; figures are meant to serve only as a rough guide.

1. Consider the service requirements

Performance requirements

The performance requirements for a protective coating include a number of factors such as: exterior or interior durability, color retention, acid or alkali resistance, adhesion, electrical properties and heat resistance. Each of these factors must be considered carefully and specific standards established.

The best standard is, of course, actual test of the product for its expected length of service. In most applications, however, this type of testing is not practical. For this reason, the next best standard consists of laboratory tests that attempt to duplicate actual operating conditions. Assume, for example, that a coating is required that will stand up under exterior exposure to salt air, sunlight and ordinary atmospheric conditions for about two years. The most commonly accepted laboratory test would be a 1000-hr salt spray test plus a 200-hr fadeometer test. Similarly laboratory tests are available for simulating almost every performance requirement.

Decorative requirements

Consideration of the variety of colors required for a product design is especially important since some coatings are only available in limited colors. The same holds true for gloss, and it is important to specify whether a coating must have a gloss, semi-gloss or flat appearance. The texture or "feel" of the coating must also be considered in many applications. If the article to be painted is a heavy, porous casting, the depth and filling properties of proposed coatings should be taken into account. The relative importance of decorative and performance requirements must be weighed carefully, and due consideration given to all factors.

Cost requirements

In addition to the cost of the coating itself, the full cost of a finish must include all direct costs relating to the coating process. In the accompanying selector chart a rough guide to material costs is given in terms of coating cost/square foot/mil dry. To this must be added an estimate of the cost of surface preparation and application.

If exterior durability and chemical resistance are required, the cost of any special surface preparation must be taken into account. If the performance requirements necessitate additional production equipment to apply the coating succesfully, then this factor must also be considered.

2. Select the type of coating

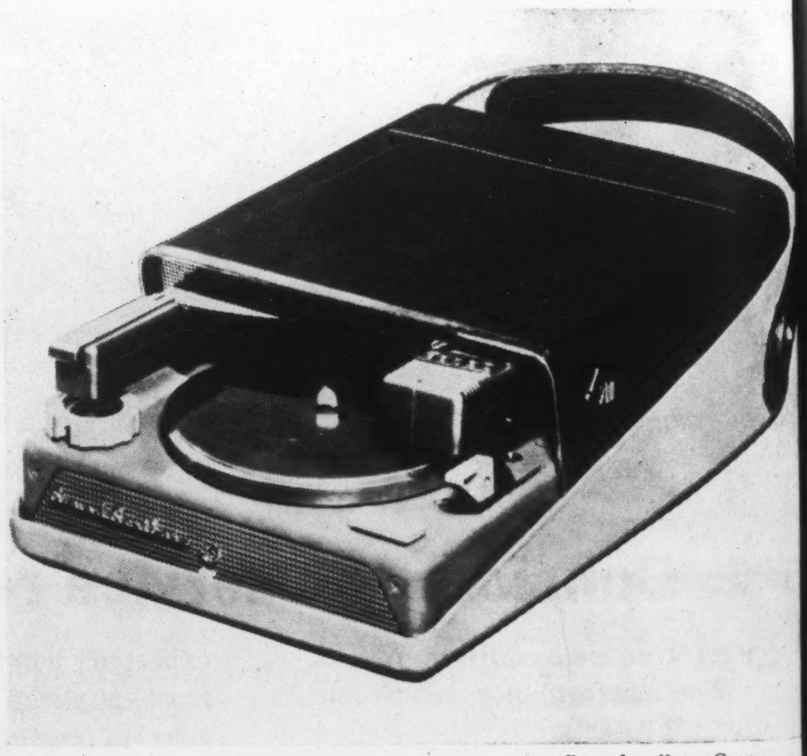
All coating requirements must be definitely established before a coating can be selected. Most of the important performance, decorative and cost requirements are listed in the left hand column of the selector chart and each of these requirements should be assigned a rating, such as excellent, very good, etc. In using this method it is suggested that where a rating has been established, all coatings of equal rating and the *next lowest* rating should be considered. For example, if the salt spray resistance required is excellent, all coatings rated excellent or very good should be considered.

A good illustration of how this selection process works is provided by the requirement for an automobile body finish. This type of finish must meet the following requirements:

Salt spray resistance: 1000 hr
Alkali resistance: Good
Solvent resistance: Good
Adhesion to ferrous metals: Excellent
Abrasion resistance: Excellent

Krylon, Inc.

Acrylic *coating provides moisture resistance and helps to retain calibration of electronic equipment during storage.*



Soundscriber Corp.

Vinyl *coating on this portable dictating machine enhances appearance and provides durable, scuff-resistant finish.*

Hardness: Very good
Flexibility: Excellent
Impact resistance: Excellent
Heat resistance: Up to 130 F
Choice of colors: Unlimited
Color retention: Excellent
Initial gloss: Excellent
Gloss retention: Excellent
Cost requirements: Reasonable

In evaluating the coatings for salt spray resistance and color retention in the selector chart, we find that the following coatings are rated excellent or very good: alkyd, alkyd-amine, alkyd-urea, alkyd-silicone, silicone, epoxy esters, vinyl, acrylic, nitrocellulose and cellulose acetate butyrate.

In evaluating the coatings for abrasion resistance, and accepting all coatings with an excellent or very good rating, we find that the alkyd, alkyd-silicone and silicone coatings are unsuitable. Since very good hardness is desired, we also find that the vinyls are eliminated when only those coatings with a very good or good rating are accepted. Similarly, an epoxy ester coating is eliminated when only those coatings with an excellent or very good flexibility rating are accepted.

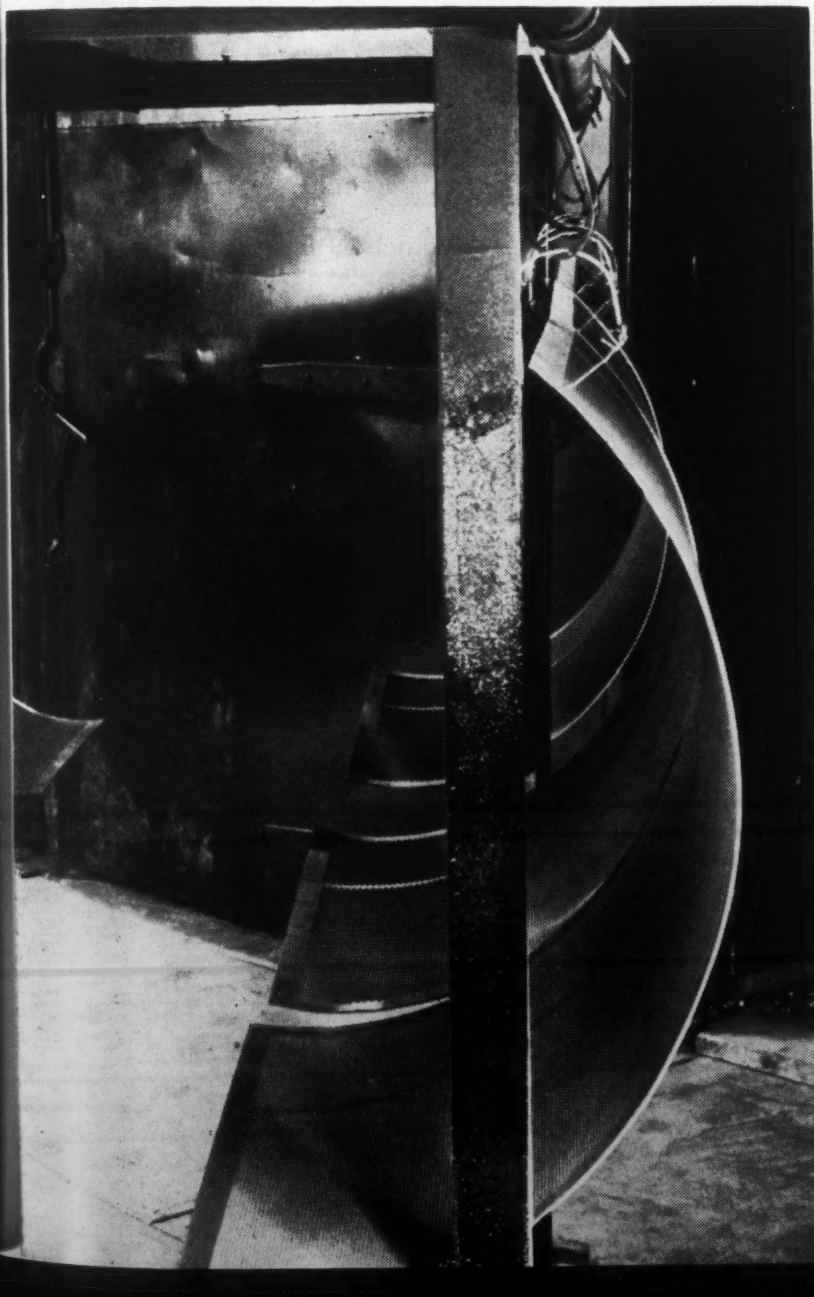
This elimination process leaves us with the choice of five suitable coatings—alkyd-amine, alkyd-urea, acrylic, nitrocellulose and cellulose acetate butyrate. The balance of the above requirements relating to alkali and solvent resistance, adhesion, impact and heat resistance, color, gloss and costs can all be met by these five coatings.

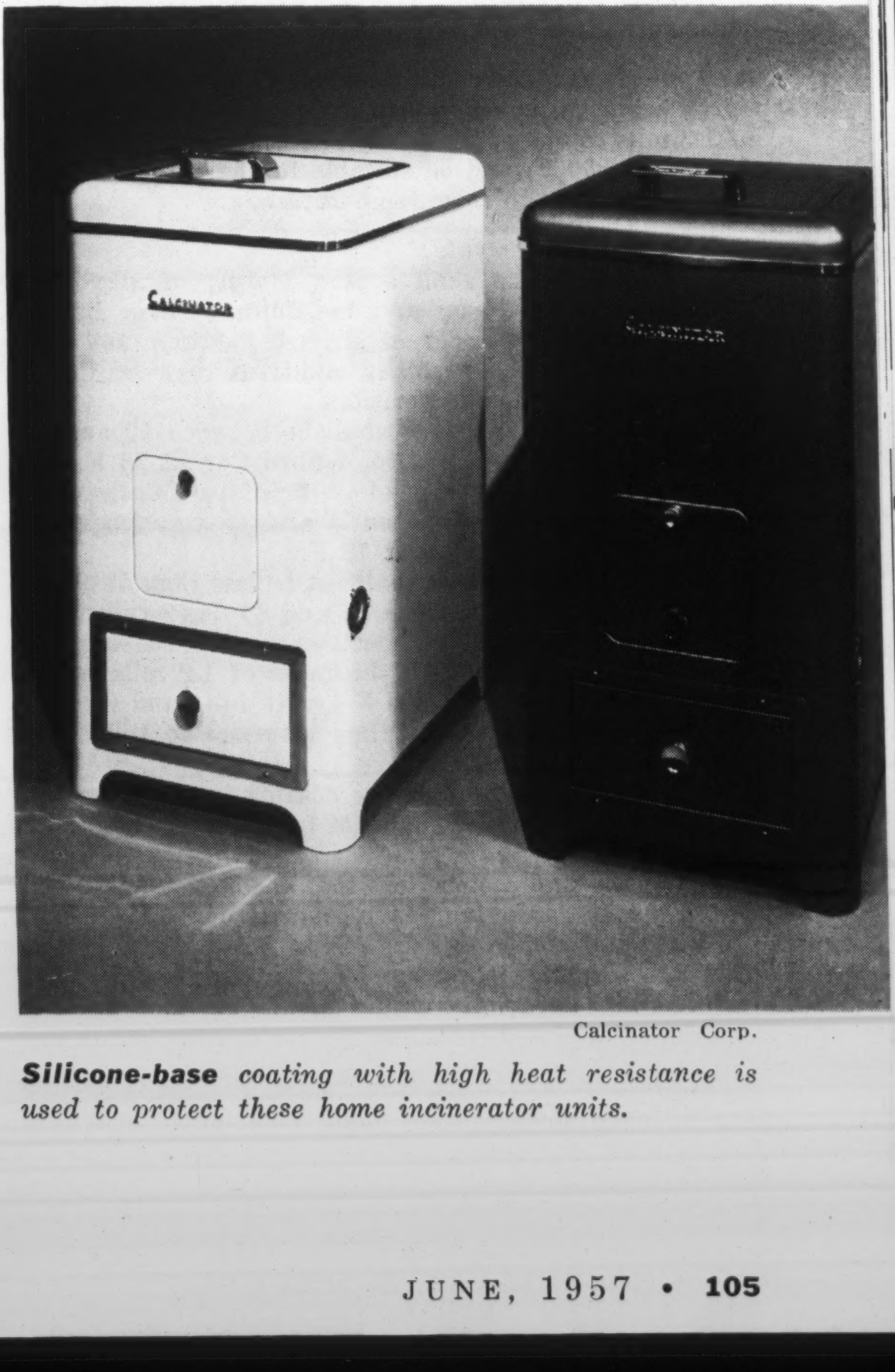
Which of the five coatings is to be selected? In general, all of them meet the requirements, although they vary individually in certain performance characteristics. In the past, some designers have favored the alkyd-amine coatings because of their superior alkali and solvent resistance, and lower cost as compared to nitrocellulose coatings. On the other hand, some designers have preferred the nitrocellulose coatings because of their superior flexibility, good color retention and smoother surface. In addition, the acrylic and butyrate coatings have gained increased popularity because of their desirable properties.

In cases such as this, where the final choice narrows down to more than one coating, it is suggested that the designer contact the technical personnel of several coating manufacturers for guidance. Most formulators produce coatings based on all of the resins listed in the selector chart, and for this reason their opinions will be more or less unbiased. In many cases the formulator can point out the advantages and disadvantages of each type of coating. With this information the designer should be able to weigh the pros and cons of suitable coatings and arrive at the one best suited for his use.

Phenolic *coating is used on these perforated screens to resist corrosive and abrasive media.*

Lithcote Corp.





Calcinator Corp.

Silicone-base *coating with high heat resistance is used to protect these home incinerator units.*

3. Prepare a specification

The purpose of a coating specification is twofold: 1) it serves as a guide to the formulator in preparing the coating vehicle; and 2) it guarantees the designer that the coating decided upon will meet his requirements. Thus, in addition to details on the coating formulation, the specification must include a number of qualitative standards as well.

A typical organic coating specification—in this case a coating for metal office partitions — is presented in the accompanying box. As shown, all performance and decorative requirements are listed in the order of their importance.

Wherever possible, laboratory standards should be set up for each requirement. For example, salt spray resistance should be specified by a minimum number of hours; abrasion resistance, by certain minimum losses after a certain number of revolutions on a standard abrasion tester; flexibility, by a minimum mandrel bend, etc. These test requirements should not conflict with each other, and the method of test should be fully explained in the specification.

To insure that the coating meets the desired cost requirements, the specification should spell out requirements for:

1. General type of resin-based coating. This must be specified in such a way as to prevent any attempted modification of the resin selected.
2. Viscosity and total percent solids of the formulation as received.
3. Viscosity for the method of application desired, after the addition of a stated percentage of a given solvent.
4. Gloss.
5. Hiding power of the coating.
6. Weight per gallon.

Typical Specification for Organic Coatings

1. *Scope:* The organic coating described herein shall be used as a one-coat system to be applied to metal office partitions.

2. *Substrate:* The surface the coating is to be applied to will be 24-gauge, mild carbon steel described in Specification No. 000.

3. *Surface Preparation:* The surface shall be cleaned and phosphated in accordance with Specification No. 000.

4. *Application:* The coating shall be applied by standard spray methods, using xylol as a reducer, in a thickness of 1.2 mils in one spray pass. The coating shall be baked 15 min at 300 F, and be suitable for handling when the metal has cooled to room temperature.

5. *Vehicle Requirements:*

5.1 Vehicle solids shall consist mainly of alkyd plus urea-formaldehyde or urea-melamine resins. Balance of solids shall consist of driers, flotation and anti-skinning agents, and other additives to meet the requirements of the specification.

5.2 Viscosity as received shall be between 50 and 150 sec as measured with a No. 4 Ford Cup at 78 F. Viscosity when one part xylol is added to four parts of the coating shall be between 16 and 35 sec as measured with a No. 4 Ford Cup at 78 F.

5.3 Total solids content shall not be less than 58%.

5.4 Gloss shall be between 25 and 35 deg as measured with a Gardner 60 Deg Reflectometer. The coating shall be applied on glass in a thickness of 1.2 mils with a knife coater, baked at 300 F for 15 min, and its gloss measured after the glass has returned to room temperature.

5.5 Wet hiding power of the coating, as measured on a Pfund Cryptometer shall not be less than 1200 sq ft per gal.

5.6 Weight shall not be less than 9.8 lb per gal.

5.7 Fineness of grind, as measured on a Hegemann Meter, shall not be less than 7.

5.8 The formulation as supplied shall be free of lumps, grit and incompatible material, and shall be capable of storage in a closed container for six months before use.

6. *Performance Requirements:* Panels finished in accordance with the above specifications must meet the following tests (tests must not begin before 24 hr, nor more than 7 days after application):

6.1 Color and gloss retention—Panels shall be subjected to 50 hr of testing in a Fadeometer and shall exhibit no noticeable deviation in their original color. A maximum gloss change of 10 deg will be allowed.

6.2 Water resistance—Panels shall be subjected to 3 cc of ordinary tap water under a watchglass for 24 hr. After 24 hr the watchglass shall be removed and the water allowed to evaporate. No change in color or gloss shall be exhibited after wiping the surface clean with a facial tissue.

6.3 Alkali resistance—Panels shall be exposed to 3 cc of individual solutions of 5% Tide and 2% caustic under watchglass for 24 hr. After watchglass has been removed, solutions evaporated, and surfaces cleaned with facial tissue, no change in color or gloss shall be exhibited.

6.4 Solvent resistance—Panels shall be exposed to mineral spirits under watchglass for 24 hr. After evaporation and cleaning no change in color or gloss shall be exhibited.

6.5 Perspiration resistance—Panels shall be exposed to 3 cc of perspiration solution under watchglass for 24 hr. No change in color or gloss shall be exhibited after the solution has been evaporated and the surface cleaned with facial tissue.

6.6 Adhesion—The coating shall remain adherent after being scored with a sharp knife by vertical and horizontal cuts spaced ¼ in. apart.

6.7 Abrasion resistance—A maximum loss of 0.3 mil shall be allowed after 1500 revolutions of a Taber Abraser using a CS-10 wheel.

6.8 Hardness—Sward Rocker hardness shall not be less than 30.

6.9 Impact resistance—Coated panels shall show no signs of embrittlement, flaking, cracking or loss of adhesion after being exposed to the impact of ½-in. steel balls dropped from a height of 2 ft.

7. *Colors:* Colors shall match standard color chips as follows and made a part of this specification:

7.1 White

7.2 Light green

7.3 Etc.

Alternate Materials Index[a]

Material	Alternate Materials Index Number
Abaca	58.00
Aluminum	0.60
Antimony	38.00
Asbestos[b]	
Amosite	910.00
Chrysotile	510.00
Beryllium	120.00
Bismuth	1200.00
Cadmium	240.00
Chestnut tannin extract	32.00
Chromium	4.40
Cobalt	68.00
Columbium	400.00
Copper	0.77
Iridium	2,100,000.00
Iron[c]	0.02
Lead	0.90
Magnesium	9.80
Manganese	0.80
Mercury	1200.00
Mica	
Muscovite block & film, stained & better	1400.00
Muscovite splittings	160.00
Phlogopite splittings	4100.00
Molybdenum	43.00
Nickel	9.30
Platinum	90,000.00
Quebracho tannin extract	10.00
Rare earths	74.00
Rubber, Natural	1.60
Rubber, Synthetic (GR-S)	1.50
Selenium	2900.00
Silver	760.00
Sisal	9.70
Talc, Natural Block Steatite	4800.00
Tantalum	2500.00
Tin	5.60
Tungsten	53.00
Vanadium	160.00
Wattle tannin extract	44.00
Zinc	1.20

[a] These alternate material index numbers do not take into account such variables as: price of the material, alloy, or product in which it is used; ease of fabrication; durability; or performance. Neither do they indicate relative priority for conservation action.

[b] National stockpile specification grades only.

[c] Inasmuch as, for metallurgical purposes in steelmaking, boron, carbon, phosphorus, silicon, sulfur, and titanium in ferrotitanium have posed no supply problem, and as they are used in minor quantities, they may be considered as part of the percentage charged to iron and be assigned the same index number (0.02) given to iron.

This list, interpreted properly, shows you

How to Choose A Less Critical Material

in designing military equipment.

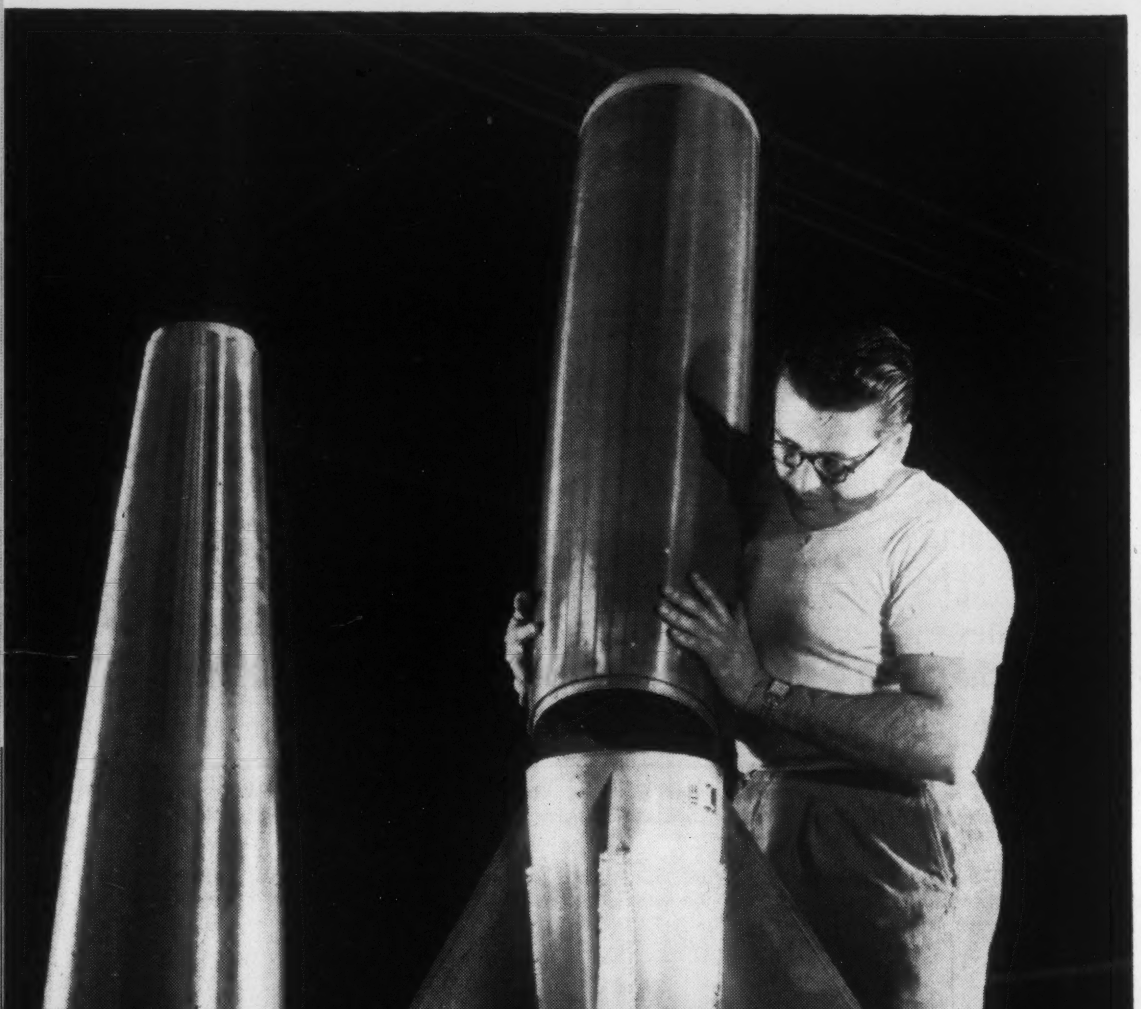
by **Franklin P. Huddle,** *Office of the Assistant Secretary of Defense.*

■ The job of selecting materials for military equipment and for civilian products is the same in many respects. However, when selecting materials for military applications, there is one important additional factor to consider—that is, the relative availability of the various materials during a period of mobilization.

The purpose of this article is to provide some basic principles to follow in judging the relative availability of materials and to describe the Alternate Materials Index that has been set up by the Department of Defense to serve as a guide for military designers and engineers.

The primary purpose for taking into account the relative availability of materials when designing military equipment is to ensure that critical materials remain available for essential uses in a time of emergency. Materials that are known to be in insufficient supply to meet essential needs under estimated mobilization conditions are called *critical.* In some cases the possibility of a mobilization shortage is related to the problem of importing a material from outside the United States. Such materials are called *strategic.*

Availability is not the reciprocal of criticalness. It is one of the factors that determine the criticalness of any given material. Only when availability is related to quantity of use and to essentiality of requirement can criticalness be determined.



Missile structures *and components must be designed with attention to the relative criticalness of materials used.*

Alternate materials index

The problem of determining the relative availability of a number of different materials in any given case is not an easy matter. Designers do not necessarily know the detailed supply circumstances of various competing materials. The need to help military designers by providing them with a single, authoritative and objective system of evaluating the relative availability of materials has long been recognized. It received considerable attention during World War II, when various systems based on different approaches and concepts were developed. Some of these took the form of "substitution" ladders. Others consisted of lists or categories based on relative criticalness.

The first practical efforts to evolve a system based on relative availability, rather than criticalness, were made by the aircraft jet engine industry about 1950. Unfortunately, these systems were based on varying assumptions and principles.

After extensive study and investigation, the Department of Defense has developed a relative availability system which now provides the designer of military equipment with a convenient and workable guide. It was first issued in 1953 and is now known as the Alternate Materials Index. It consists of a table in which various base materials are listed with index numbers which approximately indicate their relative availability under estimated conditions of mobilization.

The accompanying table is the most recent listing of the Alternate Materials Index numbers for 39 materials. These index numbers indicate what the relative availability of these materials would be under conditions of full mobilization. The lower the index number, the greater would be the availability.

The index numbers were obtained by a formula principally involving the estimated quantity of each material that would be available for a fixed period of time under estimated mobilization conditions. The formula also took into account, to some extent, the relationship between the quantity of each material available and the quantity required for essential purposes in time of mobilization.

Arriving at a figure to represent the estimated mobilization supply of each material involved many evaluations and decisions. A few of the many questions that were considered included: How reliable is the source of supply? How secure is the supply line? What percentage of the material in the ore is lost during primary processing? Should planned expansion of supply be included in the calculation?

This system of designating the relative availability of various materials has two important advantages: 1) the same formula is applied to each material in the same way to assure an objective system, and 2) the index number is chiefly based on the actual quantitative supply available under mobilization conditions. It is important to note that the index numbers do not necessarily reflect current availabilities of these materials. As an example, consider nickel. Nickel is currently quite short. However, under mobilization conditions it is reasonable to expect that the supply available from current production (virtually all from the Western Hemisphere) would not be seriously diminished. In addition, the nickel reserves in the National Stockpile would become available for use. At the same time it is reasonable to suppose that architectural, automotive and other nonessential use of nickel-bearing stainless steel would be halted. Nickel-saving boron steels and other conservation alloys would again make their appearance. Thus, the supply-demand status of nickel under mobilization conditions would be satisfactory.

The index numbers can be used for direct comparisons of the availability of various base metals. Thus, from the table it is obvious that platinum would be preferred (on an availability basis) in place of iridium, beryllium in place of platinum, cobalt in place of beryllium, nickel in place of cobalt, manganese in place of nickel, iron in place of manganese. This sequence of availabilities is known as a "substitution ladder."

Comparisons are more complicated when several highly complex alloys are to be compared. One can sometimes examine the entire pattern of two complex alloys and arrive at a fair estimate of their relative availabilities. However, in many cases the task is too complex to make a reasonably accurate estimate.

The next stage in improving the present system is to develop Alternate Materials Index numbers for all the alloys in current military use. These alloys are already coded by class and material composition in Supply and Logistics Handbook Standardization H 1A. The Bureau of Ships, Dept. of the Navy, is preparing a publication which will have the Alternate Materials Index numbers for every alloy listed in Handbook H 1A. Thus, an engineer can calculate the relative weights of the alloys suitable for a given application, multiply them by the appropriate numbers given in the new publication, and make a direct comparison of the products. The one with the lowest number is most available and the magnitude of the difference in the numbers indicates the proportion of availability. If the numbers are substantially equal, so is the availability of the constituents of the alloys. The new publication is scheduled to appear in 1957.

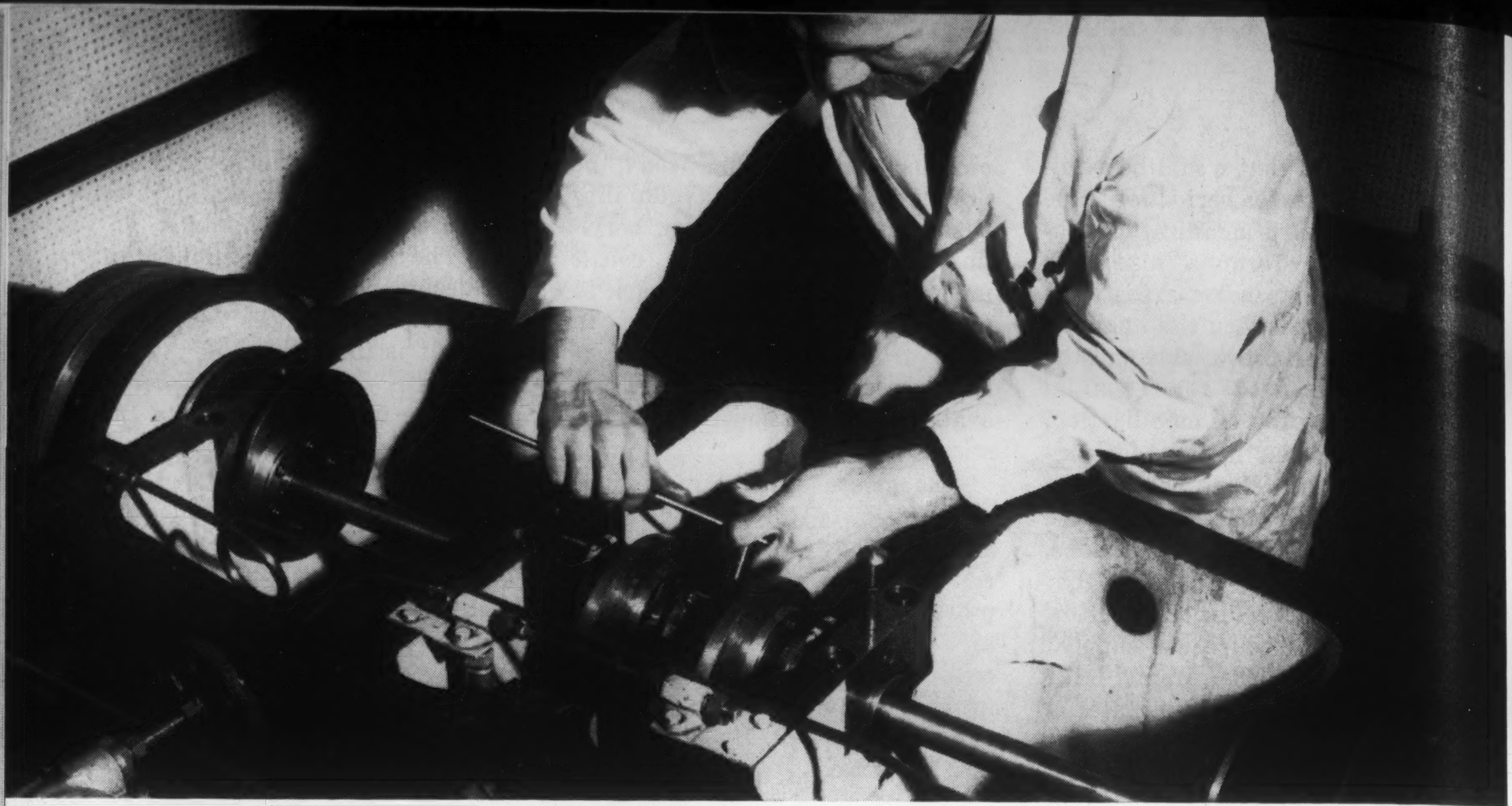
Some basic rules

Although the Alternate Materials Index numbers are important and serve as a helpful guide, they are not foolproof and are capable of misuse. The most dangerous misuse is to confuse low availability with criticalness and to accept substandard performance when there is no occasion for it.

The wisest and best way to use the Alternate Materials Index number system is in conjunction with the basic principles or rules that are listed below.

1. The first responsibility of the designer is to produce a piece of equipment that does the job for which it is intended.
2. Each and any material should be used where and to the extent it is really essential.
3. Designers should use alternate materials, but not inferior substitutes that fail to provide necessary and required performance of military equipment.
4. In any given application the most available material that is suitable should get preference.
5. If a material is known to be in insufficient supply to meet essential needs under estimated mobilization conditions (a critical material), a positive effort should be made to avoid its use.
6. Short or potentially short materials i.e., critical materials, should be reserved for those uses in which their contribution to defense production is the most valuable.
7. Where possible, designers should specify several suitable alternate materials.
8. The basis of comparison of materials is the total weight of each required to do the same job for the required life of the equipment; it is not the quantity of each initially required to make the same component. In each application durability is also a consideration.
9. No system of relative availability can indicate precise relationships in current materials supply-demand or even approximate relationships several decades in advance. Minor year-by-year fluctuations in supply or excess supply cannot be predicted or indicated in such a system.
10. Any system of relative availability guidance is worthless if used on an arbitrary basis as a substitute for common sense.

If the designer of military equipment follows the above rules and uses the availability index numbers as a guide, he will be helping in no small measure to ensure that critical materials do remain for essential uses.



***Fatigue testing** of new aluminum-tin bearings is performed in an Underwood machine under conditions simulating those in an internal combustion engine.*

Aluminum-Tin Bearings—

High Tin Types Reduce Wear

With as-cast brittleness eliminated by heat treatment, aluminum bearings containing 25 to 50% tin offer low wear and good fatigue resistance. They are particularly useful for heavy loads on unhardened steel shafts.

by E. C. Ellwood, *Chief Metallurgist, Tin Research Institute*

■ New high tin aluminum-tin bearing alloys show promise for solving problems encountered in heavily loaded high speed internal combustion engines. Although it has been known that alloys with tin contents up to 25% have improved antifriction properties over the conventional 6 to 7% tin alloys, their poor tensile ductility at elevated temperatures has made them unsuitable for heavy duty bearings. This limitation has now been largely eliminated by the addition of small amounts of copper to high tin compositions and by the development of proper heat treating techniques.

The result of these developments has been new high tin aluminum-tin bearing alloys having the desirable characteristics of tin-base Babbitt with improved fatigue strengths. Also, these alloys backed with steel can be used with unhardened steel shafts under heavy loads.

Mechanical properties

In the absence of copper, an alloy containing 30% tin has a Vickers hardness of about 22. Addition of 1% copper to the matrix, generally accepted as advantageous, raises the hardness to 27 and improves other mechanical properties of the alloy. If the copper content of the matrix is increased to 3%, the hardness rises to about 37. This is probably higher than is ideal for bearings operating against unhardened shafts and normally the addition of 3% copper is not worthwhile unless the alloy is heat treated. Solution treating and aging raises the hardness to 75 Brinell or more. Alloys in this condition have more in common with bronze than with white metal.

In the new alloys elongation increases with rising temperature, providing the tin does not exceed 40%. With 50% tin, elongation over a temperature range of 68 to 400 F remains fairly constant (see Fig 1). These changes in the mechanical properties of the alloys are important when bearings operate at temperatures above 212 F. However, at lower temperatures the effect of structure is not so important and quite massive bearings have been operated with the alloys in the cast condition.

Heat treatment

These aluminum-tin-copper alloys respond to heat treatment like binary aluminum-copper alloys. It is advantageous to cold work the alloys before heat treatment to break down the aluminum-copper compound and increase the rate of solution. Cold working also spheroidizes the tin and minimizes tin loss on the surface of the bearing during solution treatment at 930 F.

Like binary aluminum-copper alloys, these alloys do not age naturally at room temperature. Full mechanical properties are developed by artificially aging. A treatment of 16 hr at 325 F is satisfactory. It might be advantageous to install bearings in the solution treated condition for running-in and allow them to age harden under the influence of the temperature developed in the engine. Thus the bearing would be relatively soft and conformable during running-in and increase in strength during full operation.

Fatigue properties

The fatigue strength of a typical tin-base bearing alloy is about

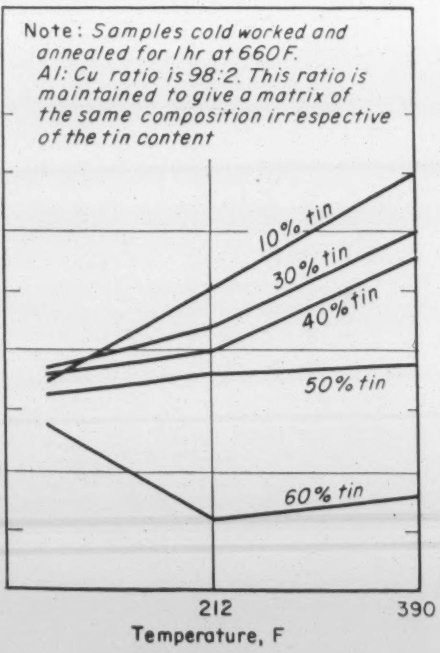


Fig 1—*Effect of tin content on elongation of cold worked and annealed alloys.*

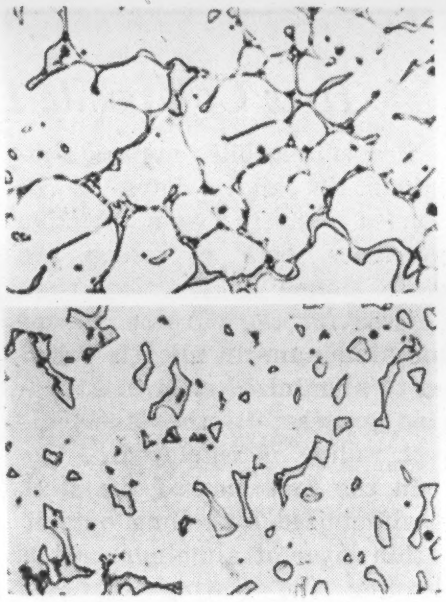
How Structure Affects Bearing Properties

Cast aluminum-tin alloys show a drop in tensile ductility at elevated temperatures because of the distribution of tin in continuous intergranular films. As the proportion of tin increases, it becomes more difficult to prevent the formation of this network, and this has been the major factor in limiting the tin content of commercial bearings.

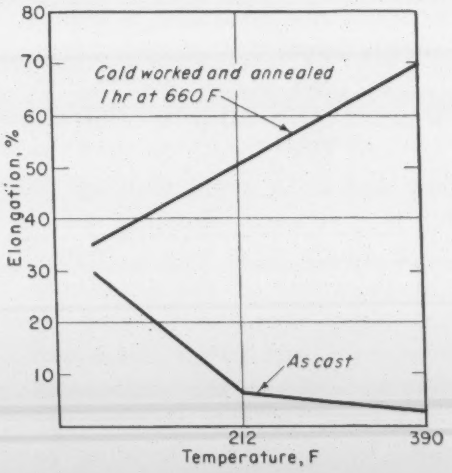
A joint investigation by the Fulmer and Tin Research Institutes showed that the distribution of tin can be influenced to some extent by casting conditions. By careful control of pouring rates, the development of a continuous network can be retarded until the tin content reaches about 15% in binary alloys, or 20% in alloys containing 2 or 3% copper. The continuous network of tin in as-cast alloys can also be broken up by coldworking and recrystallization. The accompanying graph shows the improvement in ductility.

Practically, the second method is the more attractive because it neither restricts the tin content nor demands such precise control. Annealing at 660 F after cold working recrystallizes the aluminum. At this temperature tin is liquid and is readily redistributed during the recrystallization of the matrix if cold deformation exceeds 20%. This is possible because of the large number and small size of the tin particles resulting from the deformation. Recrystallization at 660 F seems to give optimum results. Although the particles of tin are still discrete at higher temperatures, they are considerably larger than those obtained when the alloy is annealed at 660 F.

Mechanical properties of aluminum-tin alloys can be modified by the addition of suitable alloying elements, the effect being similar to that on aluminum in the absence of tin. Elements soluble in aluminum dissolve in the matrix rather than in the tin, and elements that readily form intermetallic compounds with aluminum form similar compounds in these alloys. The metallography of aluminum-tin alloys thus resembles that of aluminum alloys more closely than tin alloys. For example, when a small quantity of copper is added to an aluminum-tin alloy, it dissolves in the aluminum and hardens it. The tin is free to exercise its good bearing properties.



Structure *of 30 tin-1% copper alloy. Cast structure (above) shows tin as an almost continuous intercrystalline network. After 20% reduction by cold working, followed by annealing at 660 F (below), tin is distributed at random. (250x)*



Effect of cold working *and annealing on the elongation of 10 tin-1.8% copper alloys.*

±4000 psi at room temperature and ±2200 psi at 212 F. No figures are available for fatigue strength of this type alloy at 300 F but based on its lower melting point and the effect of temperature on other mechanical properties, it is safe to assume that the fatigue strength at 300 F is well below ±2200 psi.

The resistance to fatigue of annealed or solution treated and aged aluminum-tin alloys is much greater than that of tin-base alloys. Aluminum-tin alloys containing 30% tin have a fatigue strength of ±3000 psi at 300 F. By adding 1% copper, the fatigue strength is increased to ±4600 psi. It can be raised to 5400 psi by adding 3% copper and heat treating. (See Fig 2.)

These fatigue properties were obtained on test pieces machined from bearing alloys. They are useful to compare the properties of alloys and also give a fair guide to the performance of the alloys when used as solid bearings.

Many bearing alloys are employed in composite form, being bonded to a strong backing material such as steel or bronze. Bonding permits great reduction in thickness of the bearing alloy. Resistance to fatigue increases as the layer of bearing alloy becomes thinner and fatigue tests on a bearing alloy may be only a rough guide to the behavior of alloys when used as a bonded layer. Therefore, steel-backed bearings were prepared for service tests.

Bearing tests

An Underwood bearing testing machine was used for laboratory tests. This machine determines the fatigue strength of bearing materials under loading conditions simulating those in internal combustion engines. Preliminary tests on tin-base Babbitt bonded to steel were run under a load of 2240 psi and indicated a life of about 6 hr. This figure can be taken as a performance criterion for comparison with other materials. An increased load was required to induce failure in copper-lead bearings. With a load of 4500 psi, this type bearing failed in about 8 hr.

Tests were run on aluminum-tin bearings having a total wall thickness of 0.057 in., of which the aluminum-tin alloy layer was 0.020 in. The alloys contained either 20 or 30% tin, with and without 1% copper. These bearings carried loads of approximately 6000 psi for periods up to 100 hr before fatigue cracking began. At 4500 psi no cracking occurred after 200 hr and tests were discontinued. These results demon-

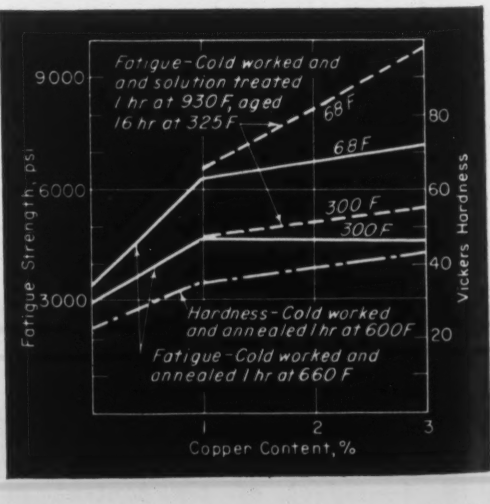


Fig 2—*Effect of copper on hardness and fatigue strength.*

How Composite Bearings Are Made

For automobile engines aluminum-tin alloys have to be bonded to steel. Two alternative processes, both of which are quite simple in practice, were devised for the purpose. In one the aluminum-tin alloy is rolled on to aluminized steel in a two-step process; in the other, direct rolling is employed.

In the first method the steel is aluminized by rolling onto it a thin layer of aluminum, after cleaning the mating surfaces and roughening them by scratch-brushing. The rolling reduction is not critical but preferably reduces the thickness of the steel by 10 to 20%. This operation does not produce a strong bond, but allows the composite strip to be heated to 750 F without oxidation at the interface. A further reduction in thickness of about 20% by rolling at this temperature produces a strong, ductile bond.

The next stage, bonding the aluminum-tin alloy to the aluminized steel, must be done below 440 F to avoid melting the tin-rich eutectic. Bonding occurs in a single pass which reduces the thickness of the aluminum-tin alloy about 50% and the steel by about 10%. These conditions enforce the differential extensions of the mating surfaces necessary for bonding between aluminum-tin alloys and aluminized steel.

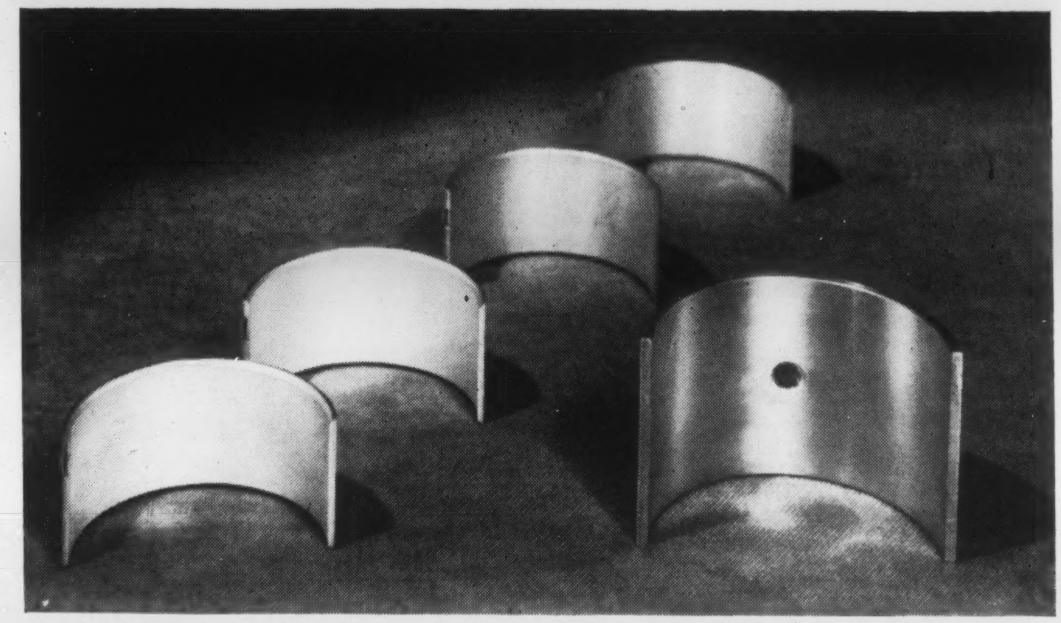
In the other method the bearing alloy is bonded directly to steel by rolling to produce equal extension of both surfaces, and avoiding the differential movement at the interface referred to above. This can only be done if the aluminum-tin alloys and the steel are of comparable hardness. For this method of bonding it is necessary to use very soft steel and hard rolled aluminum-tin alloys. The surfaces of these materials are prepared by scratch-brushing and rolled together in a single pass with a total reduction of at least 45%. Reasonably strong bonds can be obtained at room temperature but the bond strength increases as the temperature is raised to 440 F, the limit imposed by the melting melting point of the aluminum-tin eutectic.

In both methods, bonding takes place below the recrystallization temperature of the aluminum-tin alloy and the alloy is work-hardened. It must be softened by annealing for 1 hr at 660 F before manufacturing into bearings. The steel is also work-hardened but it cannot be recrystallized at temperatures below that causing rapid growth of the intermetallic compound iron aluminum compound ($FeAl_3$) at the interface between steel and aluminum. However, the hardness of the steel has not caused any difficulty in manufacturing plain bearings and even flanged bearings have been made successfully.

strate the good fatigue resistance of the alloys and show adequate bonding between bearing alloys and steel.

Laboratory tests are insufficient to convince an engineer that a new bearing material is worth adopting. No matter how promising are these tests, he always requires service trials in standard engines. A leading manufacturer of bearings in England, The Glacier Metal Co. Ltd., is manufacturing steel backed aluminum-tin bearings containing 20% tin and 1% copper on a pilot scale. Service trials have been most promising in showing absence of fatigue cracking and freedom from wear.

Since massive bearings run at lower temperatures than strip bearings in internal combustion engines, tests have been made on massive unbacked bearings with no attempt to spheroidise the tin by mechanical working or to improve the mechanical properties by heat treatment. The alloys, containing 20% tin and 3% copper to give the necessary mechanical strength, were put into service in the as cast condition with a hardness of about 45 Vickers. Rolling mill bearings of this alloy, tested in France, have given very satisfactory results on a small cold rolling mill producing steel strip.



Steel-backed aluminum-tin *bearings are produced by Glacier Metal Co. Ltd.*

A service trial was also made by the Rome tramways. Bearings having compositions shown in the table were tested on a tramcar for a year over a distance of 62,000 miles. The bearings were examined and the wear measured periodically. Test positions, shaft hardnesses wear results are given in Fig 3. The high tin alloy shows lower wear than either of the others. In all cases wear ceases after an initial period, presumably while the bearing is bedding in. For the T.R.I. and titanium-containing alloys this occurred after about 28,000 miles, but stable conditions were not reached with Lubral until almost 43,000 miles had been traveled.

Attempts to measure wear of the steel shafts showed only that it was very low and of the same order of magnitude for all three alloys.

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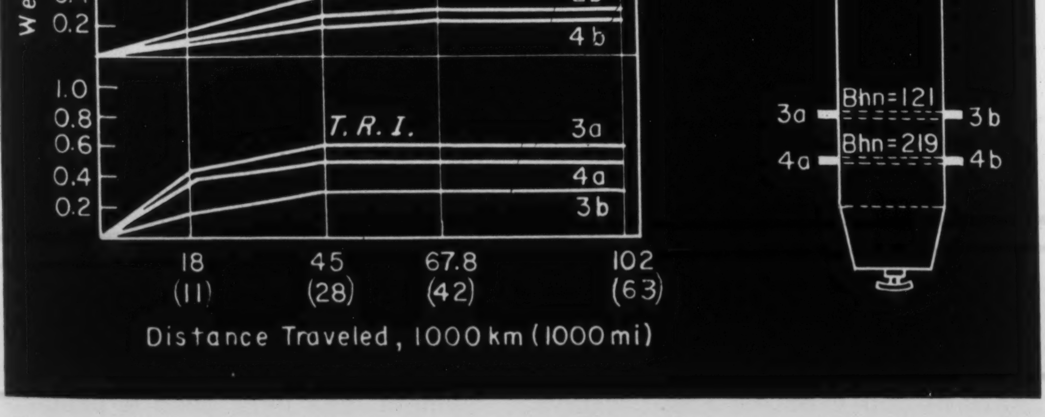

Fig 3—*Location of bearings on tramcar and Brinell hardness of shafts. Graphs show bearing wear in relation to distance traveled by the vehicle.*

COMPOSITIONS OF THE ALLOYS

	T.R.I.	Lubral	Alloy Containing Titanium
Tin	21.10	6.55	6.61
Copper	1.83	1.07	1.01
Nickel	Nil	1.04	Nil
Titanium	Trace	Trace	0.88 (avg)
Silicon	0.15	0.14	0.11
Iron	0.13	0.19	0.12
Aluminum	Balance	Balance	Balance

Selecting Silicone Rubbers

PART 2—

Properties, Design and Fabrication

This is the second of two articles intended to aid the designer in his approach to silicone rubber. It tells 1) how properties are affected by temperature and exposure to fluids, and 2) in what forms the material can be specified.

by F. L. Kilbourne, Jr., A. S. Kidwell and T. S. Moroney,

Connecticut Hard Rubber Co.

■ With six general types of silicone rubbers to choose from (see M&M, May '57, p 140, Part 1) the engineer can specify compounds to meet design requirements in a wide variety of environments. This article discusses 1) the effects of environmental conditions on silicone rubbers, 2) the compromises which must be made in specifying, and 3) fabrication and design factors which must be kept in mind by the specifier.

High temperature properties

Fig 1 shows the effect of aging a general purpose silicone rubber for a number of days at 400 F. The best heat resistant organic rubber compounds become worthless after only one or two days at 400 F. Standard silicone rubbers last almost indefinitely at this temperature and are good for a number of months at 480 F. Considering 50% ultimate elongation as the minimum for satisfactory performance as a rubber, extreme high temperature compounds are useful for about two weeks exposure at 550 F or for about 5 days exposure at 600 F (see Fig 2).

The curves in Fig 3 compare effects of temperatures up to 600 F (as measured at temperature) on an extreme high temperature silicone rubber, a high tensile-high tear silicone rubber, and natural, butyl, acrylic and neoprene rubbers. The high tensile-high tear silicone rubber, has essentially the same low slope or loss of properties with increasing temperature as the standard silicone rubber. At room temperature it has much higher tensile strength and elongation than the standard silicone rubber. As temperature increases these properties decrease, but at 500 and 600 F, it still has higher tensile strength and elongation than standard grades. In fact, it has the highest mechanical properties of any known elastomer at those temperatures.

Butyl and other organic rubbers have higher initial tensile strength values and show relatively good strength at 400 and 500 F, but elongations at those temperatures are less than 50%. Also, butyl, like other organic rubber, rapidly loses these mechanical properties when held for a short period of time at elevated temperatures.

Because of the extensive use of silicone rubbers in aircraft, properties of silicones at elevated temperatures and reduced atmospheric pressures are important. Degradation due to heating of silicone rubber in air is essentially an oxidative degradation. Consequently, reduction of air pressure during high temperature aging should result in longer service life of the compound. Figs 4 & 5 show the better thermal stability of silicone rubbers aged at reduced pressures of about 100 mm of mercury (equivalent to an altitude of about 48,000 ft) as compared with those aged at 760 mm (sea level). As can be seen, aging at reduced pressure extends the service life well beyond the duration of the test and probably for several weeks or more.

Reversion or softening of silicone rubbers, occurring when the rubbers are aged at elevated temperatures in a completely closed system, has long been a problem. This effect had made curing of thick sections of silicone rubber

High temperature properties

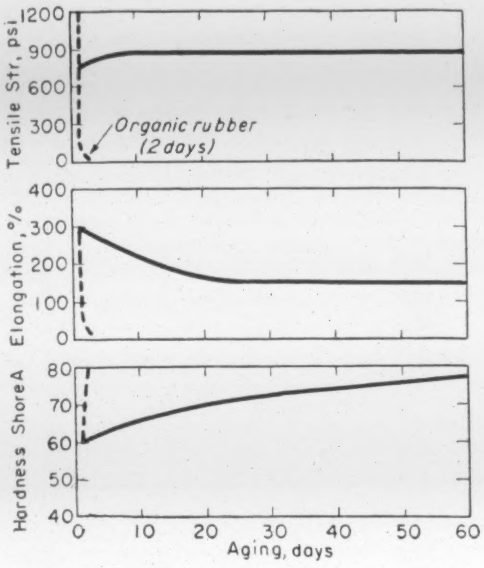

Fig 1—*Effects of aging at 400 F on* general purpose *silicone rubber.*

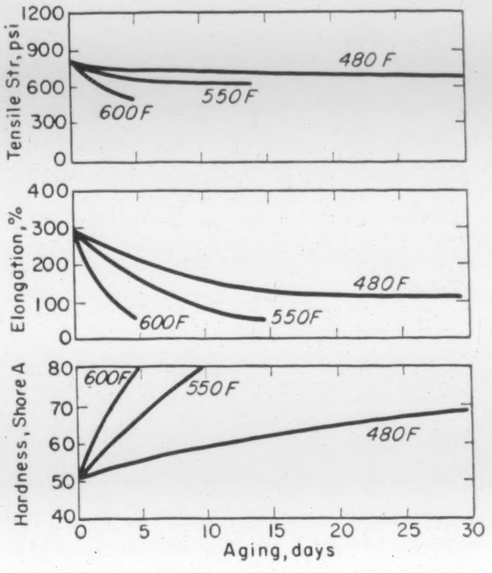

Fig 2—*Effects of aging at three temperatures on* extreme high temperature *silicone rubber.*

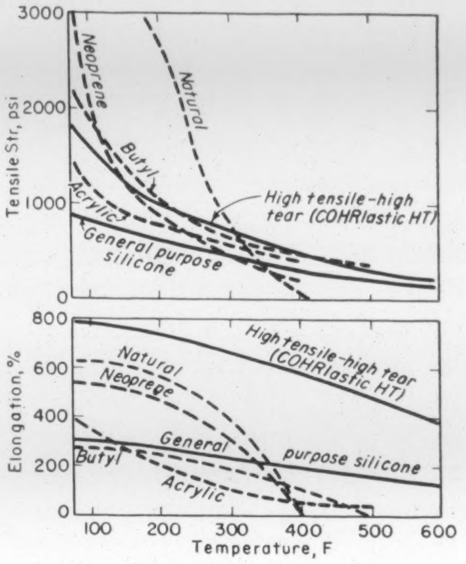

Fig 3—*Instantaneous high temperature properties of six rubbers (measured at temperature).*

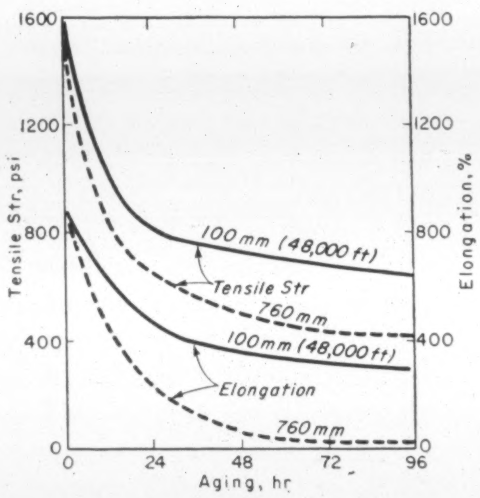

Fig 4—*Effects of aging at 480 F and reduced pressure on* high tensile-high tear *silicone rubber (COHRlastic HT).*

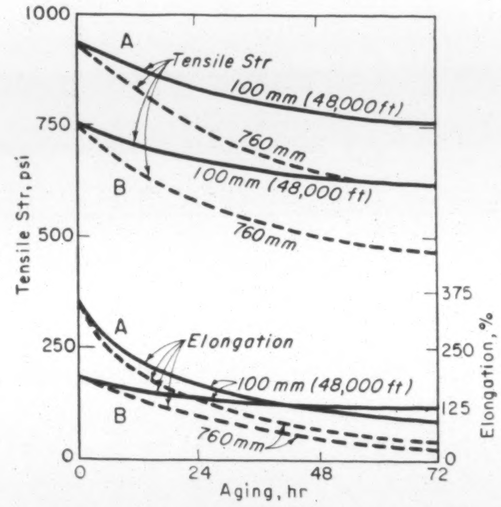

Fig 5—*Effects of aging at 600 F and reduced pressure on two* extreme high temperature *silicone rubbers designated A and B.*

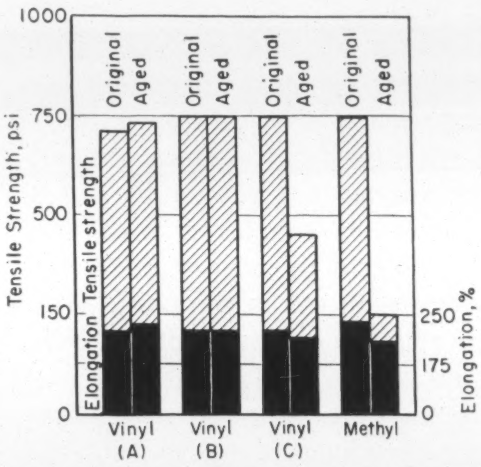

Fig 6—*Reversion resistance of four silicone rubber stocks is determined by comparing properties after aging for 4 hr at 500 F in bomb pressurized at 100 psi. The three vinyl-type compounds were catalyzed as follows: A—ditertiarybutyl peroxide, B—tertiarybutyl perbenzoate (both alcohol-type catalysts), C—benzoyl peroxide (small amount). Standard methyl compound was catalyzed with benzoyl peroxide.*

troublesome, and in many cases impossible, due to reversion and sponging in the center of the piece. The common source of this trouble is the benzoic acid residue remaining in the rubber after curing with a standard acid peroxide catalyst. Recent development of the methyl-vinyl silicone gums has greatly reduced this problem. These gums can be cured with much smaller amounts of the acid peroxides, or, if necessary, with the alcohol-type peroxides. Resistance to reversion can be further improved by selection of proper fillers. Fig 6 compares tensile strength and elongation of three types of vinyl gums with those of a standard methyl gum after heating for 4 hr at 500 F under 100 psi pressure (conditions calculated to cause reversion). Resistance to reversion of the vinyl gum compound, which was vulcanized with only a small amount of acid peroxide, is better than that of the standard gums; however, maximum results were obtained with vinyl gums catalyzed with the alcohol type peroxide.

Low temperature properties

The low temperature effects on silicone rubbers normally measured are caused by the first order transition, or crystallization. Straight methyl polymers crystallize relatively rapidly at temperatures of —75 to —90 F. Modification of the polymer chain by introduction of either phenyl or vinyl groups lowers the crystallization temperature thus improving low temperature characteristics. Crystallization also occurs relatively slowly over a wider temperature range. In commercial silicone rubbers the degree of improvement in low temperature flexibility obtained with the vinyl side-chain addition is only about 10 or 15 deg F. The addition of phenyl groups can lower the crystallization temperature 60 deg F or more to a crystallization temperature of —150 F or lower.

Fig 7 shows the effect of low temperatures on two silicone rubbers, one made with a standard methyl gum, the other with a methyl-phenyl gum. Because there is a considerable amount of disagreement on methods of measuring low temperature properties of rubbers, Fig 7 compares Young's modulus in flexure (ASTM D-797), brittle point by flexure (D-726), and brittle point by impact (D-746).

Effects of temperatures from —100 to 500 F on hardness and compression set characteristics of an extreme low temperature silicone rubber are shown in Fig 8. Hardness is compared with that of a general purpose rubber, and compression set is compared with that of a low compression set compound.

In various temperature ranges compression set is due to different causes. At low temperatures, it is partially due to plastic flow but mainly to increased stiffness caused by crystallization. At room temperature, set is mainly caused by plastic flow in the compound. At elevated temperatures, set is caused in part by increased plastic flow and in part by an extended cure that takes place while the material is in the compressed state.

Fluid resistance

Resistance of silicone rubbers to fluids such as hydraulic fluids and fuels has been relatively poor. The new fluoro-silicone rubber promises to eliminate this drawback. It shows outstanding resistance to aromatic oils, aromatic fuels, jet fuels, diester-based oils, MIL-O-5606 hydraulic fluid, phosphate ester hydraulic fluids and silicate ester hydraulic fluids. Resistance to most of these liquids at room temperature is nearly equivalent to or better than that of the best organic rubbers, and resistance at elevated temperatures is far superior to that of any organic rubbers.

Silicone rubbers in general show good resistance to a wide variety of oils, solvents and chemicals. They are comparatively little affected by ordinary lubricating oils, animal oils, vegetable oils, alcohols, and most dilute acids and alkalies. They are swelled considerably by solvents, such as benzene, toluene, carbon tetrachloride and gasoline. Fig 9 shows the effect of four selected test fluids on several silicone rubber compounds. Note the improved resistance of the low compression set compound over the general purpose compound, and the extremely small effect of the fluids on the new fluoro-silicone.

In general, most rocket propellants have deleterious effects on silicone rubbers. In unusual cases, special silicone rubber compounds can offer a satisfactory compromise in fluid resistance in order to meet special temperature requirements. For example, a properly compounded silicone rubber can be used in contact with concentrated hydrogen peroxide, and still supply the required operating flexibility at extremely low temperatures.

In considering the fluid resistance properties of a rubber compound the designer or engineer should bear in mind the difference between swelling and destruction. Although some liquids will swell a rubber compound as much as 200% or more in volume, after evaporation of the liquid the properties of the rubber may remain essentially unchanged. Other fluids may cause relatively slight swelling, but may cause gradual destruction of the polymer itself. Such fluids usually drastically effect the rubber's properties measured immediately after immersion, and cause permanent loss of properties after removal of the fluid.

Most solvents, fuels and lubricating oils will only swell and temporarily reduce mechanical properties of silicone rubber compounds. After removal of the fluid, properties are almost completely recovered. Other fluids such as aromatic lubricating oils, MIL-O-5606 hydraulic fluid, diester oils and silicate ester hydraulic fluids slowly destroy the rubber by depolymerization and solution. Note in Fig 9 the low

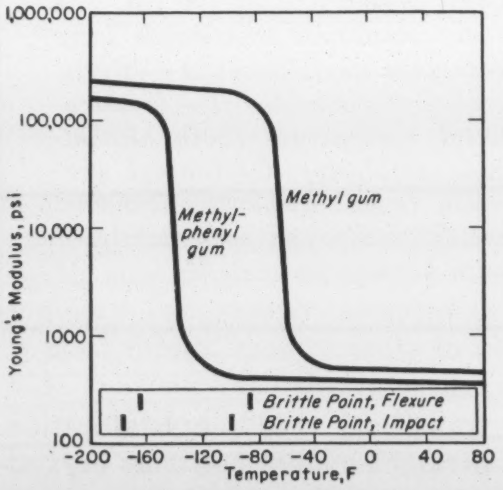

Fig 7—*Effects of reduced temperatures on a standard methyl gum and an* extreme low temperature *type methyl-phenyl gum. Curves show Young's modulus. Brittle points by both flexure and impact are shown at bottom (lower values are for methyl-phenyl gum).*

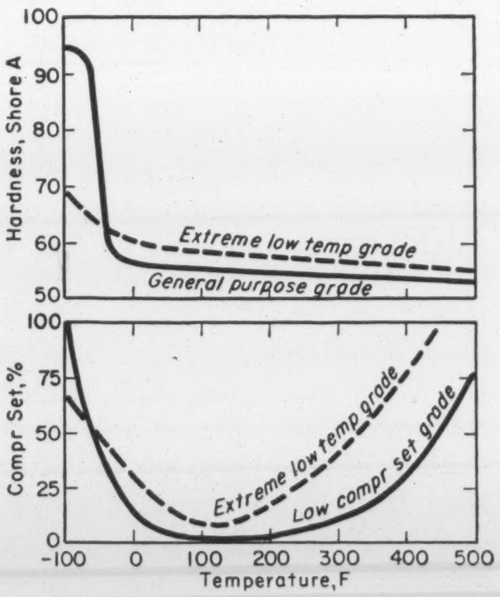

Fig 8—*Effects of various temperatures on hardness and compression set of an* extreme low temperature *grade are compared with effects on a* general purpose *grade and a* low compression set *grade.*

. . . these secondary properties must be compromised as shown ➤ To emphasize these properties . . . ▼	Tensile Strength, psi	Tear Strength, lb/in.	Resistance to ASTM #1 Oil[a]	Resistance to ASTM #3 Oil[b]	Resistance to Compr Set,[b] %	Stability at 480 F[c]	Stability at 600 F	Low Temperature Flexibility, F	Reversion Resistance
Tensile Strength		200	Normal—	Normal	70 (22/300)	No (400 F)	No	—120	No
Tear Strength	1000		Normal—	Normal	70 (22/300)	No (400 F)	No	—120	No
Resistance to ASTM #1 Oil	600	55		Normal	10–15 (22/350)	Yes (600 F)	Yes	—120	Yes
Resistance to ASTM #3 Oil	650	35	Normal+		35 (22/300)	No (450 F)	No	— 90	No
Resistance to Compression Set	600	55	Normal+	Normal		Yes (600 F)	Yes	—120	Yes
Stability at 480 F	600	55	Normal	Normal	10–15 (22/350)		Yes	—120	Yes
Stability at 600 F	600	55	Normal	Normal	10–15 (22/350)	Yes (600 F)		— 85	Yes (Good)
Low Temperature Flexibility	1000	200	Normal	Normal	25 (22/350)	Yes (600 F)	Yes		Yes
Reversion Resistance	600	55	Normal	Normal	10–15 (22/350)	Yes (600 F)	Yes	— 85	

[b] Figures in parentheses indicate conditions of test, e.g., 22 hr at 300 F. [c] Temperatures indicate actual stability limits.
more than" the normal resistance that can be expected of slicone rubbers.

[b] Figures in parentheses indicate conditions of test, e.g., 22 hr at 300 F. [c] Temperatures indicate actual stability limits.

Compromise is a 'must' in specifying silicone rubber

For purpose of simplification, this chart assumes that a design engineer is seeking the best possible combination of only two silicone rubber properties. The primary property sought is listed on the vertical axis. The value for the best possible secondary property is found listed under the corresponding heading on the horizontal axis.

For example, if high tensile strength is the primary property desired, tear strength values on the order of 200 lb per in. can be obtained. However, slightly lower than normal resistance to ASTM 1 oil must be tolerated. Also, in order to gain maximum tensile strength, compression set must be sacrificed along with 480 and 600 F heat stability. Good low temperature flexibility characteristics can be obtained, but resistance to reversion must be sacrificed.

The chart is based on specification values and consequently is somewhat more conservative than the data given elsewhere in the article.

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volume swell but large property loss of silicone rubbers in the diester lubricant.

Silicone rubbers resist vapors of a destructive liquid better than they resist the liquid itself. Fig 9 also compares resistance of three types of silicone rubbers to fluids and to their vapors. Note particularly that Skydrol 500 at 300 F decomposes the rubbers, while the vapor at this temperature does them no serious harm. Obviously in many cases where resistance to vapor alone is required, or where redesigning will allow exposure only to the vapor, silicone rubber can be used with fluids previously considered completely incompatible with the rubber.

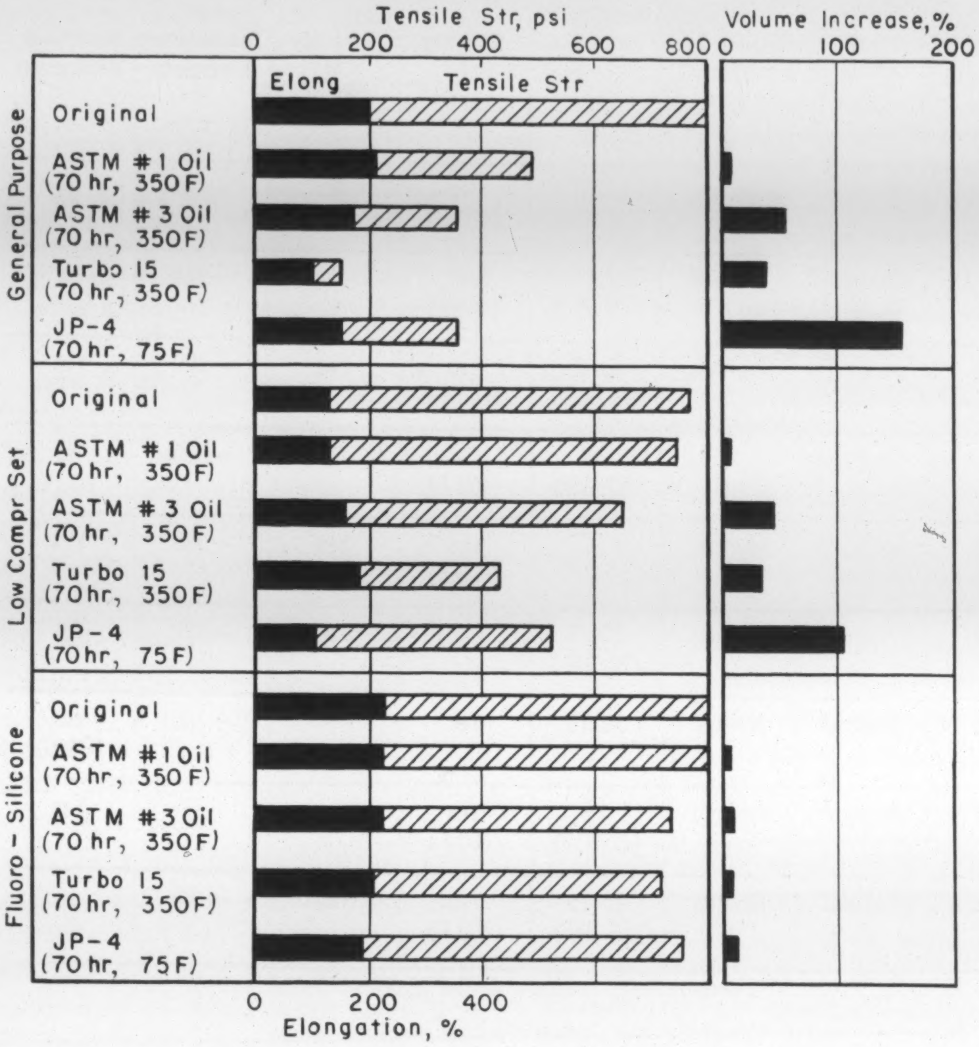
Electrical properties

Electrical properties of silicone rubber compounds are comparable to those of the best organic rubbers in the ordinary temperature range. Moreover, silicone rubbers maintain these electrical properties over a temperature range of —100 to 500 F or higher. Also, resistance to ozone, corona and weathering is exceptional.

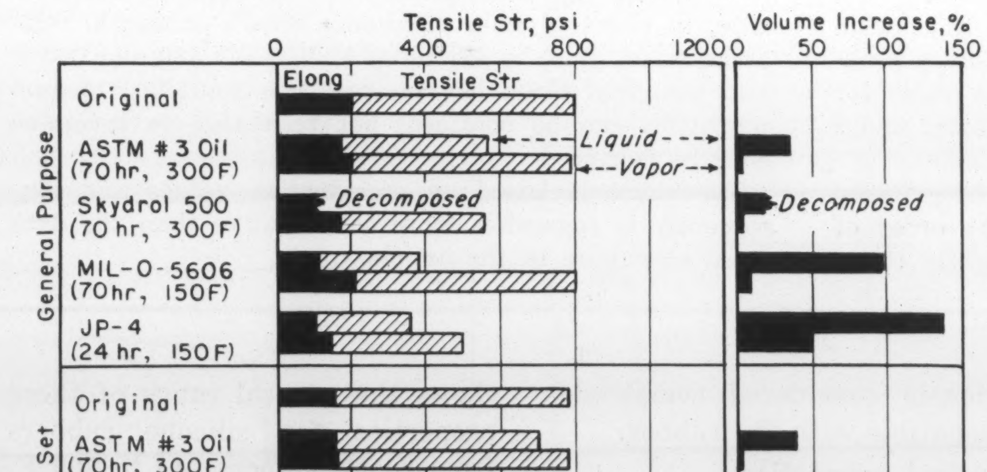
At low power frequencies or direct current, the properties normally considered for a rubber insulator are dielectric strength and volume resistivity. Fig 10 shows the general range of these properties for silicone rubbers from room temperature to 500 F. Dielectric strength of most silicone rubber compounds rises slightly with increasing temperature up to about 200 F, followed by a slight decrease up to 500 F. Total change is generally less than 10 or 15%. Volume resistivity changes from about 10^{15} ohm-cm at room temperature to about 10^{11} ohm-cm at 500 F.

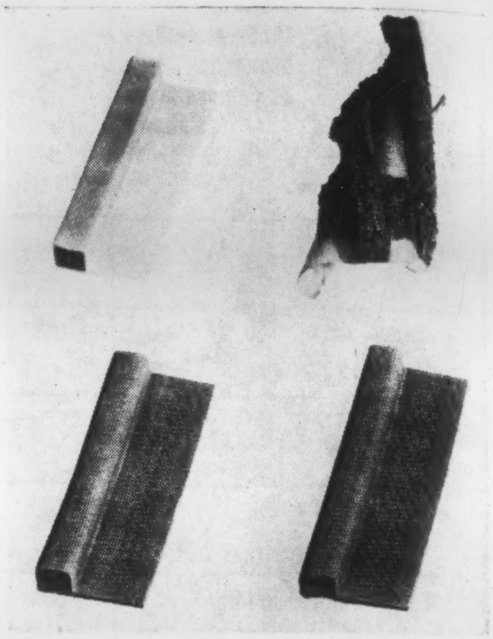
At high frequencies, dielectric constant and power factor of an insulator become quite important, Fig 10 also shows variation of these properties over the range of

FIG 9—EFFECT OF LIQUID IMMERSION AND . . .



. . . LIQUID IMMERSION VS VAPOR IMMERSION





***Fluoro-silicone rubber's** resistance to fluids is graphically shown by this comparison between an ordinary fabric-reinforced silicone rubber seal (top) and a seal constructed of the new rubber (bottom). Specimens at right have been soaked in AN-F-48 (100/130 octane) fuel for 16 hr at room temperature.*

100 cycles to 10,000 megacycles per sec. Most silicone rubbers show relatively small change in this frequency range, and in a temperature range from room temperature to 400 F.

Of course, these curves show only general values for electrical properties. Electrical properties, as well as other properties of silicone rubber, can be varied widely by use of various fillers and additives. Dielectric constant can be varied rather easily from about 2.7 up to 5.0 or higher and power factor can be varied from 0.0005 to 0.1 or more by compounding.

Electrically conductive silicone rubber compounds, have recently been developed. These grades make use of the vinyl type gums cured with the alcohol peroxides to permit the use of carbon black fillers which provide the conductivity.

Conductive silicone rubbers can be prepared covering the same range of conductivity covered by the conductive organic rubbers; i. e., from about 10 to 10^{15} ohm-cm resistivity. Their resistivity changes only very slightly after flexing or stretching. Conductive

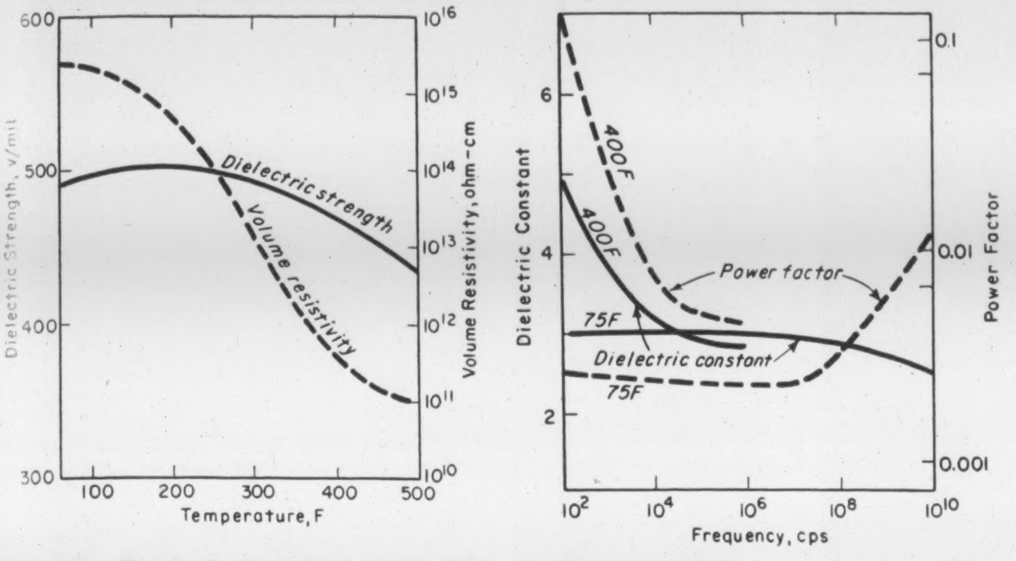


Fig 10—Typical electrical properties of silicone rubbers.

compounds have physical properties similar to those of general purpose silicone rubbers, though they have somewhat poorer resistance to elevated temperature aging.

Fabricating characteristics

Silicone rubbers can be extruded, molded, calendered, sponged and foamed. Compounding of the rubber stock determines to a great extent the fabrication or processing characteristics of the material as well as its end physical properties. Consequently the compounder should be consulted before the material is specified, to determine whether compromises must be made in order to obtain the best combination of physical properties and the most desirable shape.

In addition to standard extrusions and moldings, silicone rubbers can be applied to fabrics by calender coating, knife spreading or solvent dispersion techniques. In certain sealing applications, extremely low durometer stocks are required. For these applications, sponge, foam or low durometer solid stocks can be specified.

As defined here, silicone sponge is of closed cell structure; silicone foam is of open cell structure. The distinction is arbitrary, based on method of manufacture rather than on characteristics of the final fabricated part. Sponge is expanded by chemical release of gasses in a solid stock. Foam is usually blown by whipping air into latex. Properties of sponge, foam and low durometer solid stock are compared in an accompanying table. In general, when specifying silicone sponge or foam rubbers the following parameters are used: 1) density, 2) compression deflection, and 3) high and low temperature limits.

Sponge is available as molded sheet for gasket cutting or packing, as extrusions and as simple molded shapes. As in the case of solid silicone rubber, molded or extruded sponge can be fabricated in a variety of ways by bonding to fabric or plastics, thus improving resistance to abrasion or fluids.

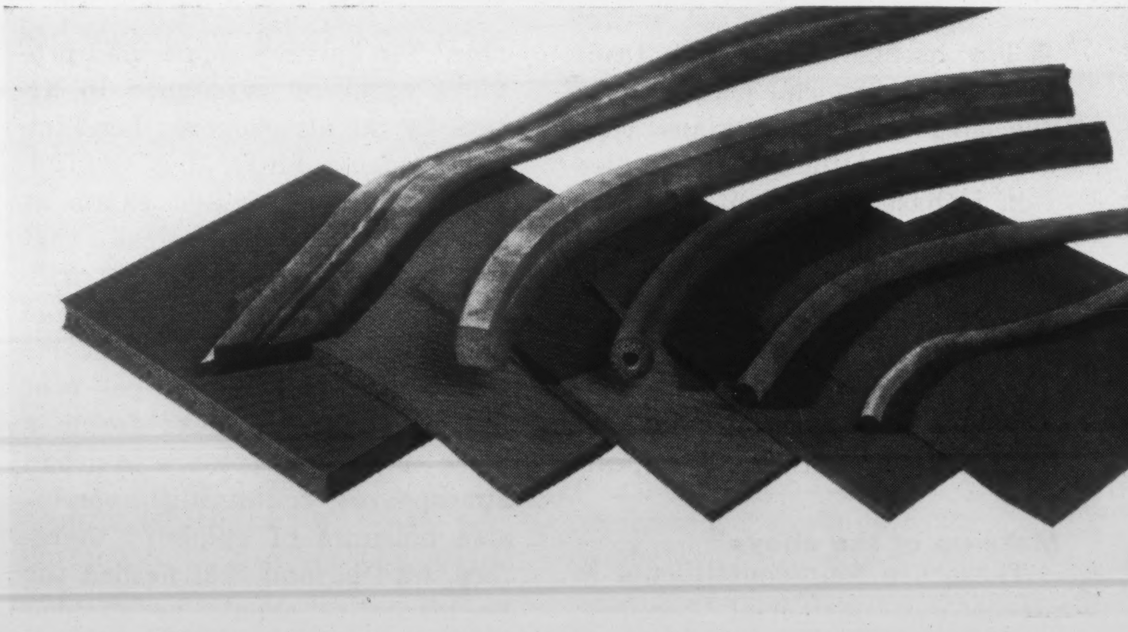
Silicone foam rubber is relatively new. It can be fabricated in heavy cross-sections and complex shapes. It is suitable for use where an extremely soft, low density silicone material is required. Like sponge, it can be bonded to fabrics and plastics to provide useful sealing constructions.

In some applications a solid, low durometer material has advantages over sponge or foam. For example, a solid low durometer stock should probably be specified for gaskets or seals where the low compression set of foam, the compression-deflection characteristics of sponge, and the higher tensile, tear and elongation properites of solid silicone rubbers must be combined.

A COMPARISON OF SOFT SILICONE RUBBERS[a]

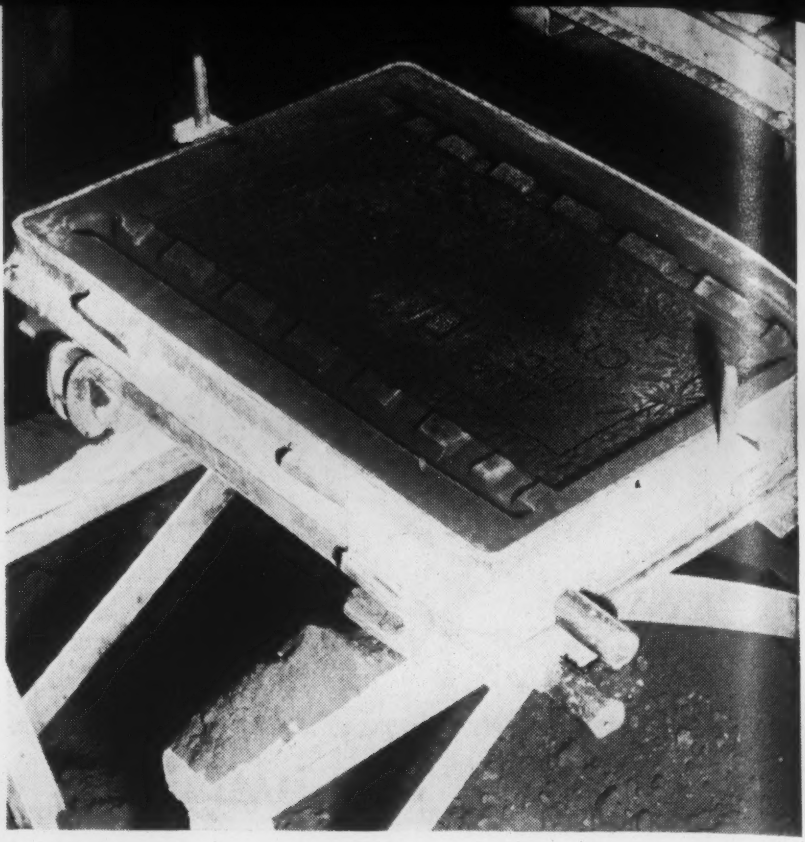
	Sponge			Foam (1 in.)	Low Durometer Solid Stack (1/16 in.)
	Slab 1/16 in.	Slab 1/2 in.	Extrusion		
Density, lb/cu in.	0.57	0.25	0.35	0.14	0.64
Compression-Deflection (stress at 25% compr), psi	12	7	6	0.75 to 1.25	20
Compression Set, % orig deflection					
22 hr at 70 F	40	56	50	—	—
22 hr at 350 F	90	90	90	20	30

[a] None of these materials showed any stiffening or cracking when bent 180 deg at —100 F, and none showed any cracking when bent 180 deg after conditioning of 70 hr at 480 F.



Sponge silicone rubber *can be used for a variety of soft sealing or vibration absorption applications.*

1. Sand mold is made *and matchplate pattern removed from the drag. Fine facing sand is used to obtain an excellent surface on the casting.*



2. Drag face is skin dried *with a flame before mold is closed.*

Bronze
for Memorial Plaques

Excellent corrosion resistance plus ability to match natural weathered finishes on bronzes by artificial coloring before installation make bronze the logical choice for memorial plaques.

by Robert J. Nekervis, *Battelle Memorial Institute*

■ Tin bronzes have been traditional for memorial plaques since the time of the Sumerians, circa 3500 B. C. Although their selection is based on tradition rather than on properties, in this case the material has also proved to be well suited to requirements. Tin bronzes have excellent resistance to the atmosphere, good castability, are readily machined and have the necessary aesthetic appearance.

Make-up of the alloys

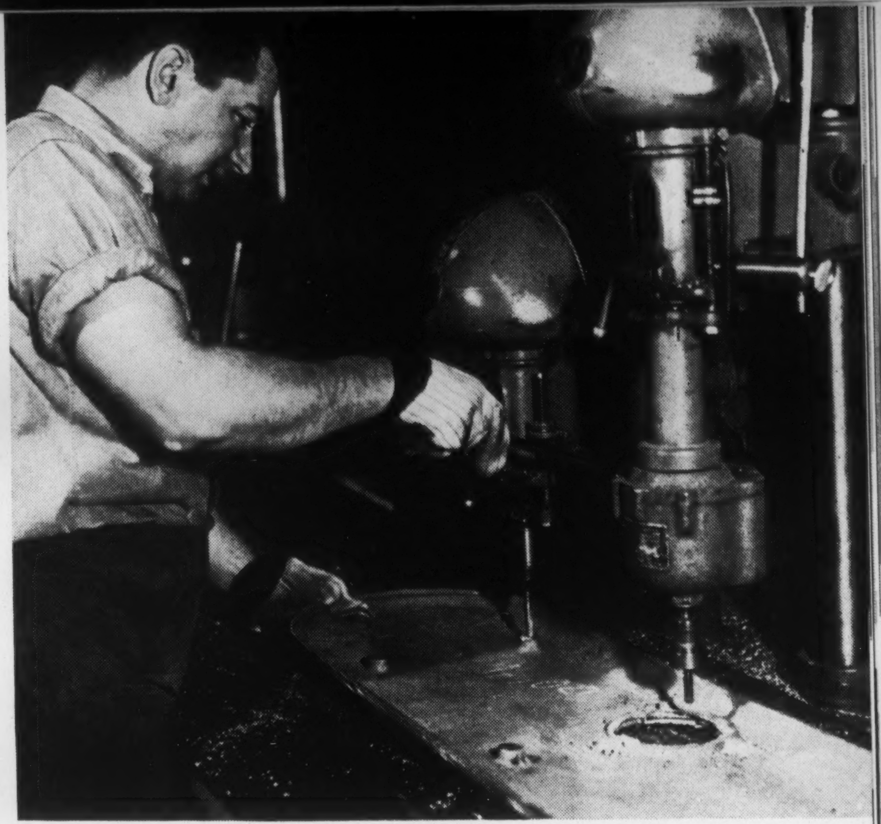
There are four constituents in present-day memorial bronzes; the major ones are copper and tin, and the minor ones are lead and zinc. Tin hardens copper and provides excellent resistance to attack by the atmosphere. Lead imparts machinability. It is immiscible in the bronze and exists as discrete droplets of lead that break up the chips formed in drilling, tapping, and machining, and make these necessary operations less costly. One to two per cent lead is sufficient. Lead forms a black sulfide on exposure to urban atmospheres containing appreciable amounts of sulphur; therefore, lead beyond that needed for machinability should be avoided because it tends to accelerate discoloration.

Since present-day memorial bronzes are almost universally sand cast, ordinarily in faced, skin-dried molds, present practice is to use some zinc in the tin bronze because of improved castability. The chief contribution of zinc is the retardation of gas absorption through the vapor pressure set up during melting. Consequently, the finished casting is less porous. Zinc also penetrates the cavities in the sand mold to a lesser extent than other common deoxidizers, such as phosphorus, and yields a better quality surface under a given set of conditions.

Zinc is added even though tin is twice as effective in imparting strength, has more effect on the color of the alloy, and imparts more resistance to atmospheric corrosion. Strength and corrosion considerations limit the amount of zinc so used, and the American Society of Testing Materials classifies tin bronzes as copper alloys containing up to 20% tin, with zinc less than tin.

Because of these factors, the various memorial park associations specify a tin bronze containing sufficient lead and zinc to accomplish the desired effects. A typical specification is ASTM Designation B61-52 for high-grade steam valve bronze having

3. **Plaques are poured** *on a conveyorized casting line.*



4. **Holes are drilled and topped.** *Large center hole is machined out to receive an invertible bronze vase.*

a nominal composition of: 88 copper, 6 tin, 1½ lead, 4½% zinc. This falls within the ASTM definition of a true tin bronze and provides a narrow composition range within which a satisfactory degree of color matching can be achieved.

Coloring and highlighting

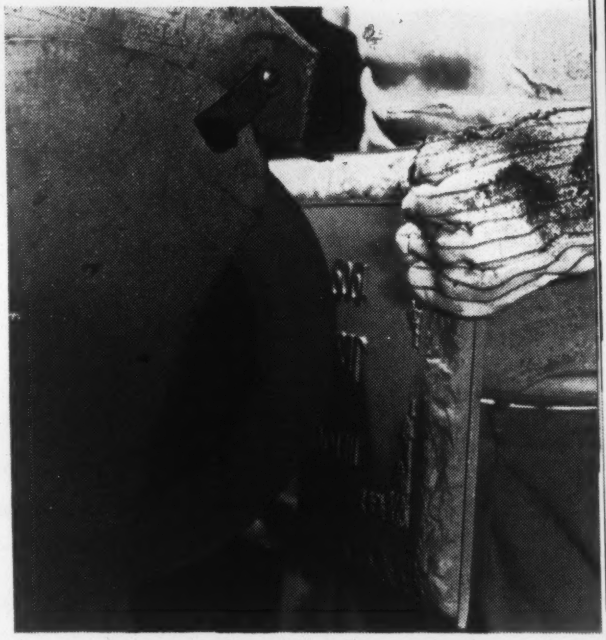
All copper alloys tarnish, but the tarnish on tin bronze has an aesthetic appeal. Advantage is taken of this by chemically coloring the bronze plaque before installing it, so that it will blend with the natural weathered finishes on the bronzes already in place. On a single composition this entails different finishes for different areas of the country: light brown statuary finishes for predominately rural areas; darker brown statuary finishes for urban areas that have a considerable sulfur content in the atmosphere; green verde finishes for coastal areas, etc.

Much effort has been expended on finding suitable finishes to permit an aesthetic blending of the new and old. An example is the development of a sulfur-free chemical coloring process to replace the old liver-of-sulfur solutions that accelerated the onset of blackening of the plaques.

Chemical coloring is only part of the story. Provision must be made for highlighting or the entire surface of the plaque will be a dull oxide color. There are many ways of accomplishing this. One method is buffing the raised portions of the bronze plaque before coloring and preventing wetting by the coloring solution in these areas by proper selection of the constituents of the polishing compound. There are other effective methods. In all, the metallic appearance of the plaque is achieved by exposing the metal in the raised portions of the plaque and also letting it shine through the colored surface in adjacent areas.

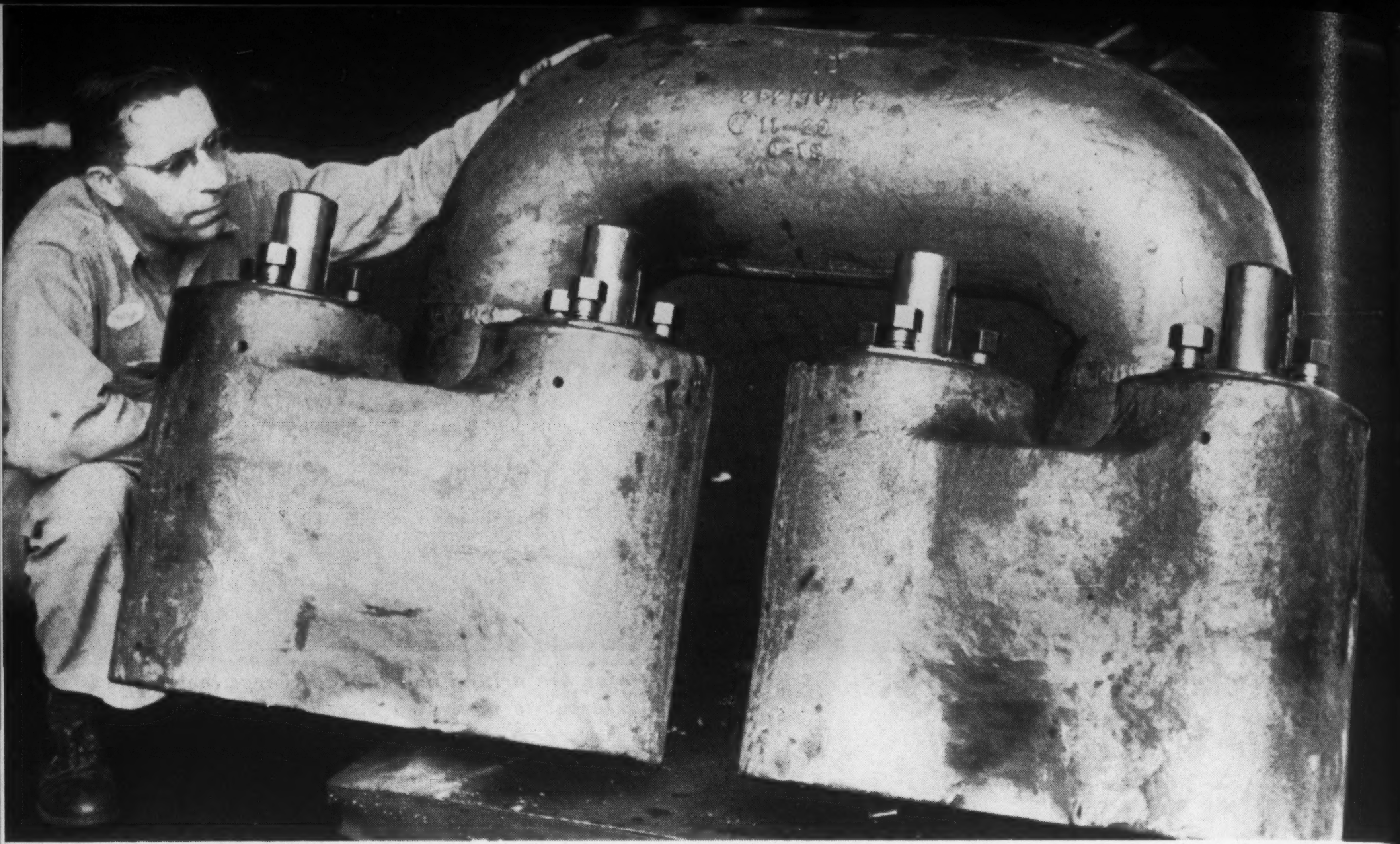
For aesthetic reasons the hue and tone of the highlighted areas should be consistent from plaque to plaque. This is accomplished by specifying a particular grade of tin bronze and it is customary to use standard bronze specifications as a guide.

With tin about $1.00 per lb and zinc 14 cents per lb, tin bronzes may seem excessive in cost for a material to be used as a memorial. However, the necessity of providing a bronze that is truly "a bronze of the ages" that will harmonize with other bronzes of varying vintage from several sources makes their use mandatory.



5. **Raised portions are highlighted** *by buffing to produce contrast between lettering and chemically colored background.*

In some quarters the use of a high-grade bronze for such a purpose is considered wasteful. From a financial standpoint the high cost of the artistic effort going into the manufacture of the memorial more than offsets the cost of the material. From a strategic standpoint such bronzes can be considered a stockpile to be used in the event of extreme need, a circumstance which, unfortunately, has happened many times in history.



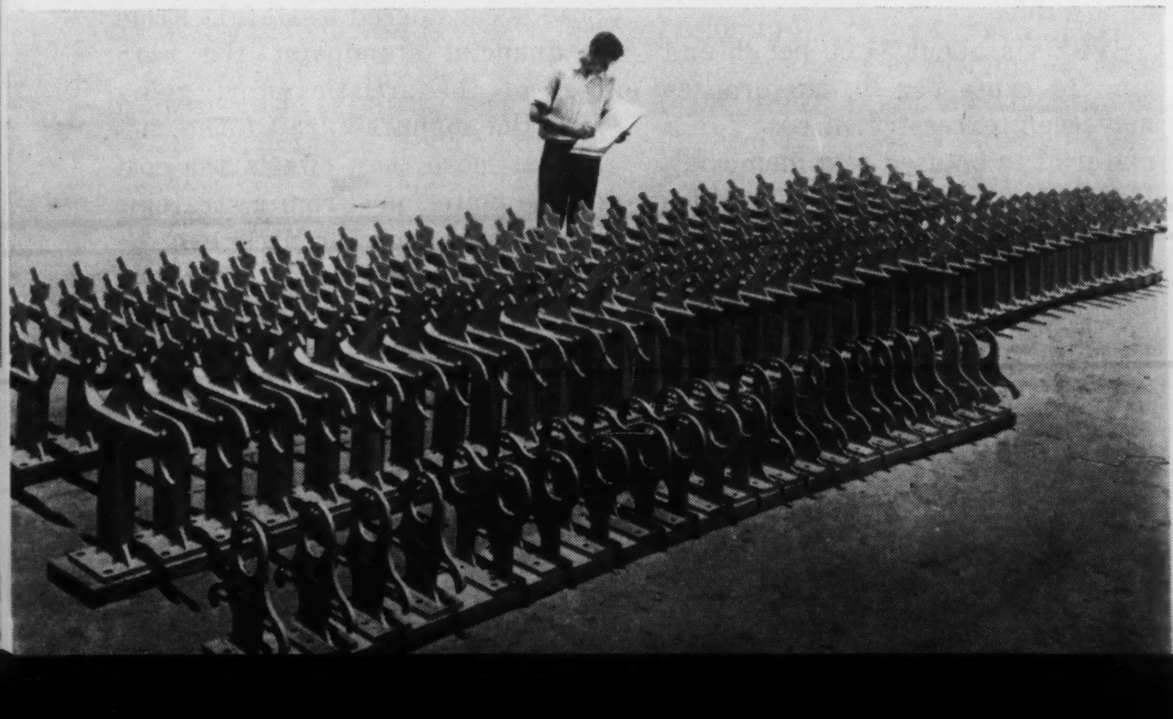
Refinery fitting *of type HA is used for service at 950 F under a pressure of 800 psi. This four-hole header is produced by welding two cast two-hole terminals to 180-deg U-bend cast from the same alloy. Fitting must meet ASTM specification A217-55, Grade C12, which covers pressure-containing parts for high temperature service.*

Where to Use Heat Resistant, High Alloy Castings

Here is a useful, illustrated guide to the selection of heat resistant iron-chromium-nickel castings. See also the data sheets starting on page 151.

by E. A. Schoefer, *Executive Vice President, Alloy Casting Institute*

Tube supports *are produced from type HH for service in radiant sections of oil refinery heaters at temperatures up to 1650 F. Hanger castings weigh from 35 to 60 lb.*



■ Iron-chromium-nickel alloys are the largest group of metals in general commercial use for the temperature range 1200 to approximately 2150 F. Many of these materials are used as castings for applications in heat treating equipment, industrial furnaces, petroleum refining equipment, process industry equipment and similar purposes. The accompanying photographs indicate the wide variety of uses of heat resistant castings in industry.

Fourteen alloys, ranging in

composition from 9 to 17% chromium and from 0 to 66% nickel comprise the major casting alloys of this type. The wide range in composition is responsible for quite a variation in physical and mechanical properties and resistance to the environment. These characteristics must be considered in selecting a material for a specific service. Properties and characteristics are given in the tables on pages 151 to 155 (File Facts) in this issue of MATERIALS & METHODS.

In the cast form these heat resistant alloys are designated by two letters: *H* (denoting heat resistant to distinguish this series from the corrosion resistant series identified by the initial letter *C*) and a second letter, representing the nominal nickel-chromium content. The second letter ranges from *A* to *X* in the order of increasing nickel.

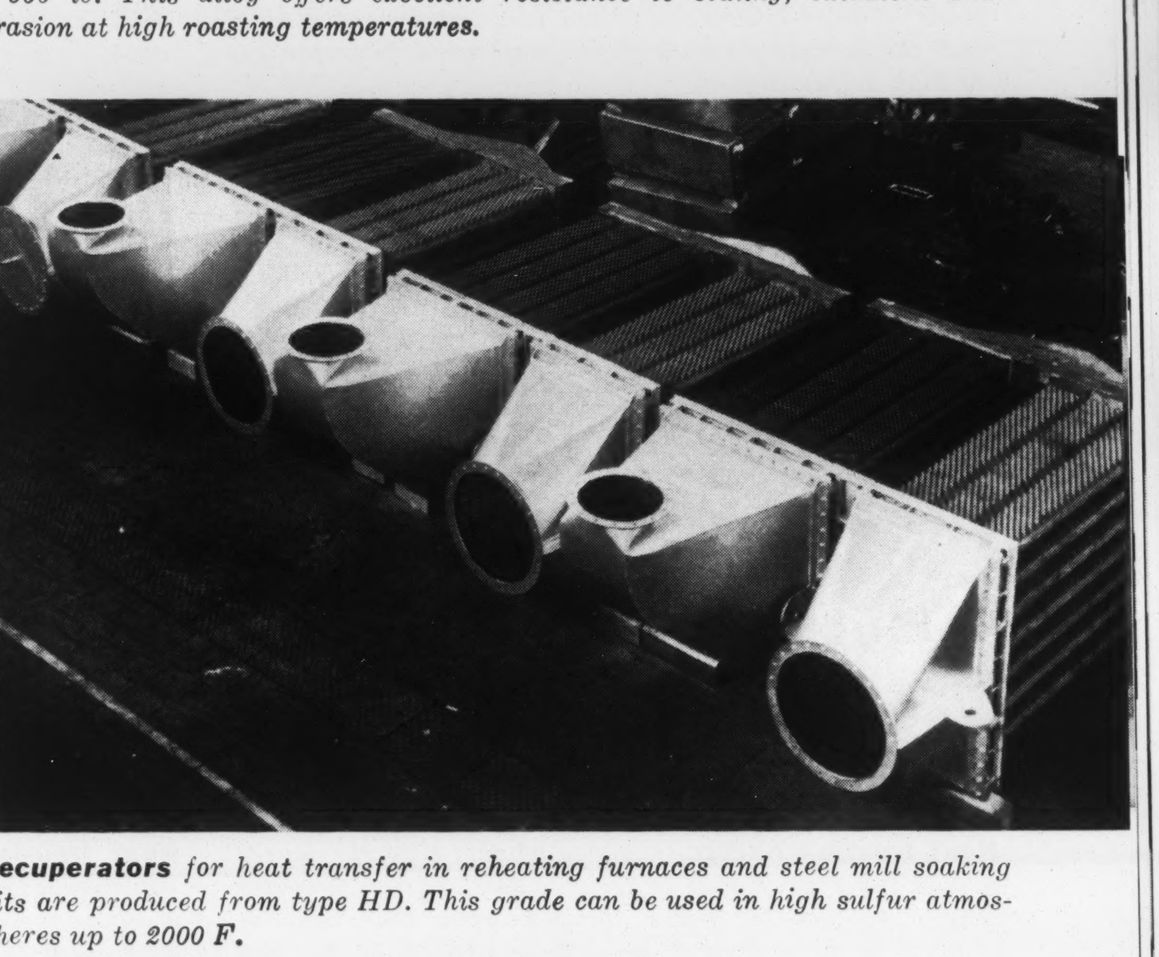
Three alloy groups

These alloys fall into three distinct groups:

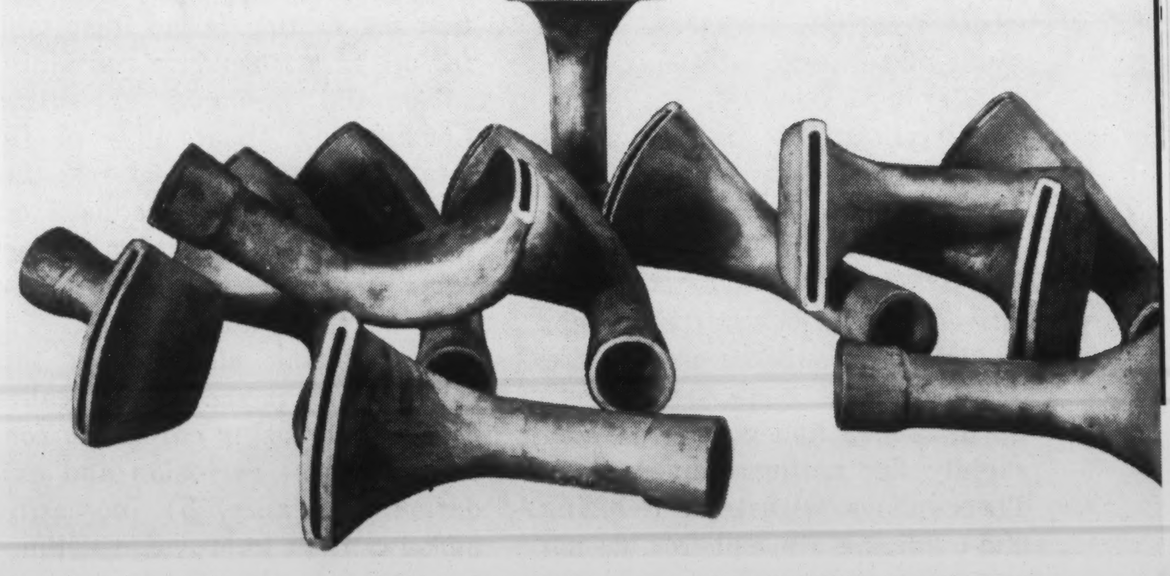
1. *Iron-chromium alloys.* They contain 8 to 30% chromium, and under 7% nickel (types HA, HC and HD). These ferritic alloys offer excellent resistance to oxidation and sulfur-containing atmospheres. The HA type is useful only to 1200 F, but the higher chromium grades are suitable for low stressed applications to 2000 F. Typical applications include oil refinery fittings, fan blades for hot gases, trunnions for glass rolls, rabble arms and blades in ore-roasting furnaces, salt pots and grate bars for heat treating.

2. *Iron-chromium-nickel alloys.* They contain 19 to 32% chromium and 8 to 22% nickel, with chromium higher than nickel (types HE, HF, HH, HI, HK and HL). Partially or fully austenitic, these alloys have greater high temperature strength and ductility than the iron-chromium group. They withstand greater loads and temperature cycles, and can be used in sulfur-bearing, oxidizing and reducing atmospheres. Among these alloys, Type HH is used in greatest quantity, and is the general purpose grade. Applications

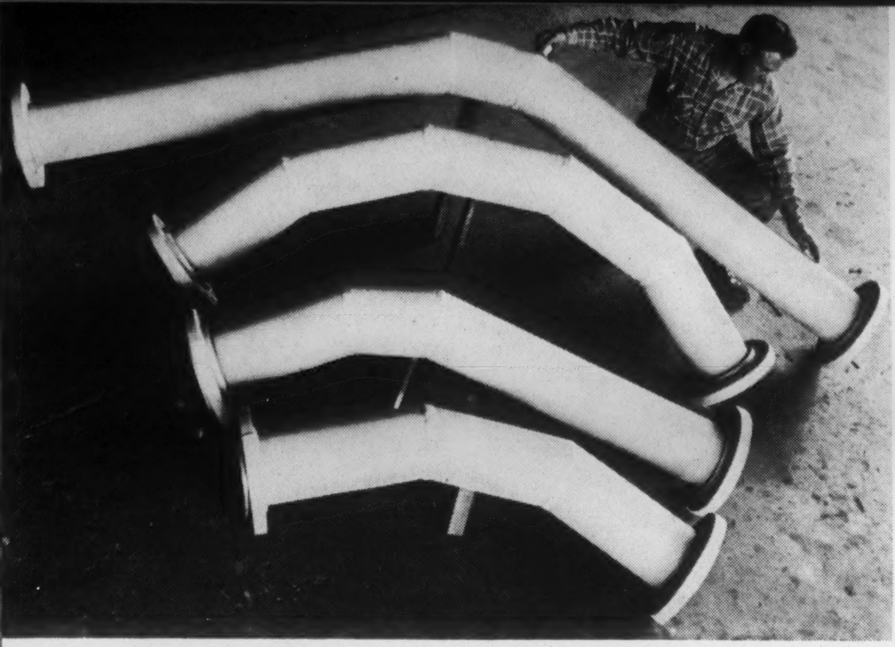
Rabble arms *cast from type HC for use in vertical ore roasters weigh 200 to 600 lb. This alloy offers excellent resistance to scaling, oxidation and abrasion at high roasting temperatures.*



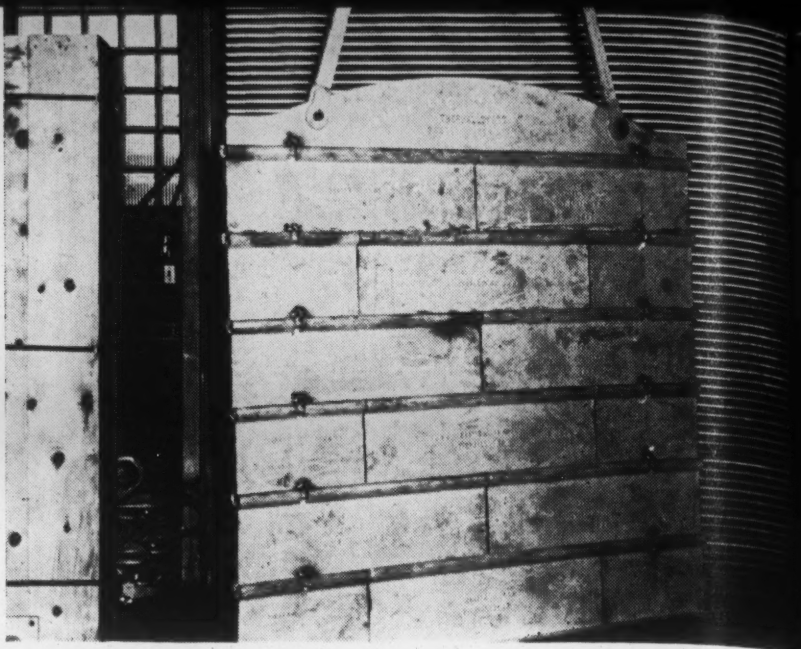
Recuperators *for heat transfer in reheating furnaces and steel mill soaking pits are produced from type HD. This grade can be used in high sulfur atmospheres up to 2000 F.*



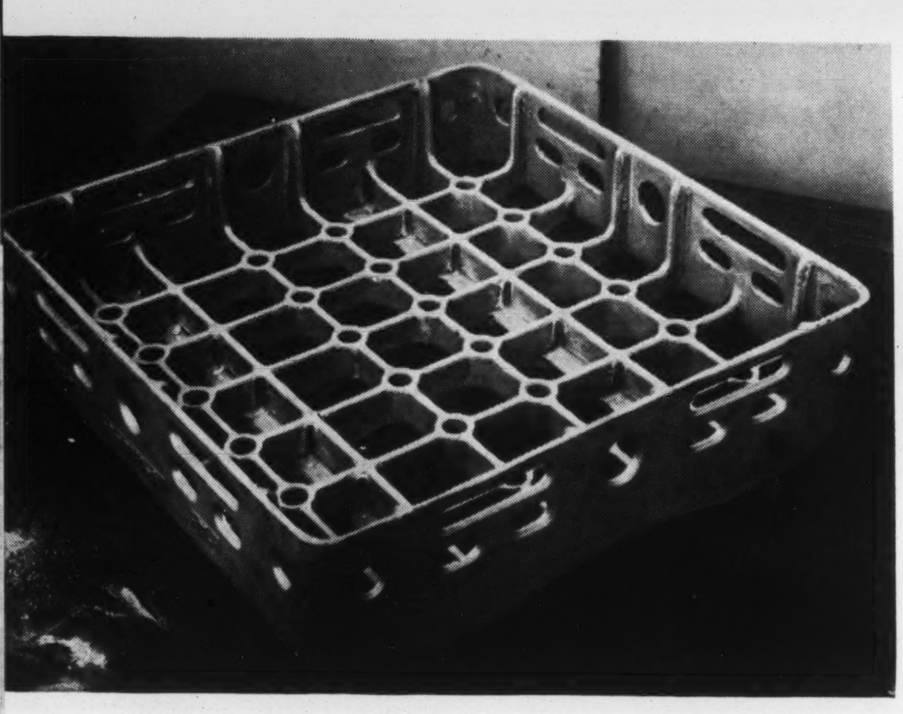
Burner nozzles *of type HE are used in power plant applications. These nozzles operate at temperatures up to 1800 F.*



Radiant tubes, *used in heat treating furnaces, are made of type HL to withstand temperatures of 2000 F and the corrosive action of hot anthracite producer gas of high sulfur content.*



Sectional furnace damper, *assembled from type HF castings, resists high temperatures and corrosive gases at high gas pressures. Used in connection with a steel mill soaking pit, this damper weighs about 1500 lb and is 5 ft, 9 in. wide and 5 ft, 10 in. high.*



Heat treating fixture, *a group of cast type HT leaves pinned together loosely to form a flexible grid, provides strong support for gears through cycle that includes heating to 1700 F and quenching. Slotted hollow box members of same alloy keep leaves in position.*

Heat treating tray, *cast from type HU for use in a gas fired annealing furnace at 1750 F. In a typical annealing operation the tray carries approximately 270 lb of small gear forgings.*

for these alloys include parts for heat treating furnaces, power plant and cement mill equipment.

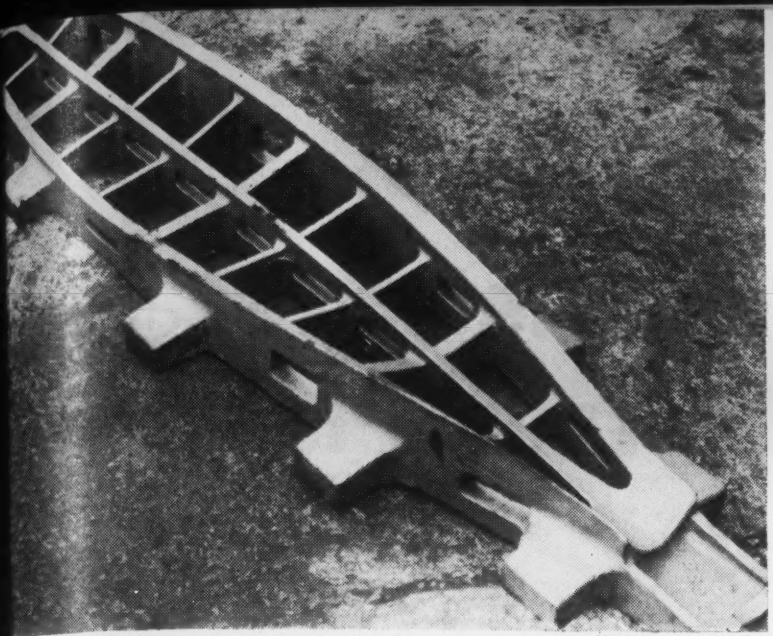
3. *Iron-nickel-chromium alloys.* They contain 23 to 68% nickel, and 10 to 23% chromium (types HN, HT, HU, HW and HX). These alloys have a stable austenitic structure, and are not as sensitive to variations in composition as the high chromium grades. They have excellent hot strength up to 2100 F and good life under rapidly fluctuating temperatures. These alloys withstand reducing and oxidizing atmospheres, do not carburize excessively, and do not take up nitrogen in a nitriding atmosphere. The high nickel content makes this group unsuitable for use in atmospheres containing substantial amounts of sulfur. Constituting about 40% of the total production of heat resistant alloys, these alloys are used extensively in heat treating furnace parts and auxiliary equipment such as trays and fixtures.

In selecting alloys from this third group, it should be recalled that a) increasing chromium content improves corrosion and oxidation resistance, b) increasing nickel content improves resistance to carburization and thermal shock, but gives somewhat lower hot strength, c) increasing silicon improves resistance to carburization but decreases hot strength, d) increasing carbon improves hot strength.

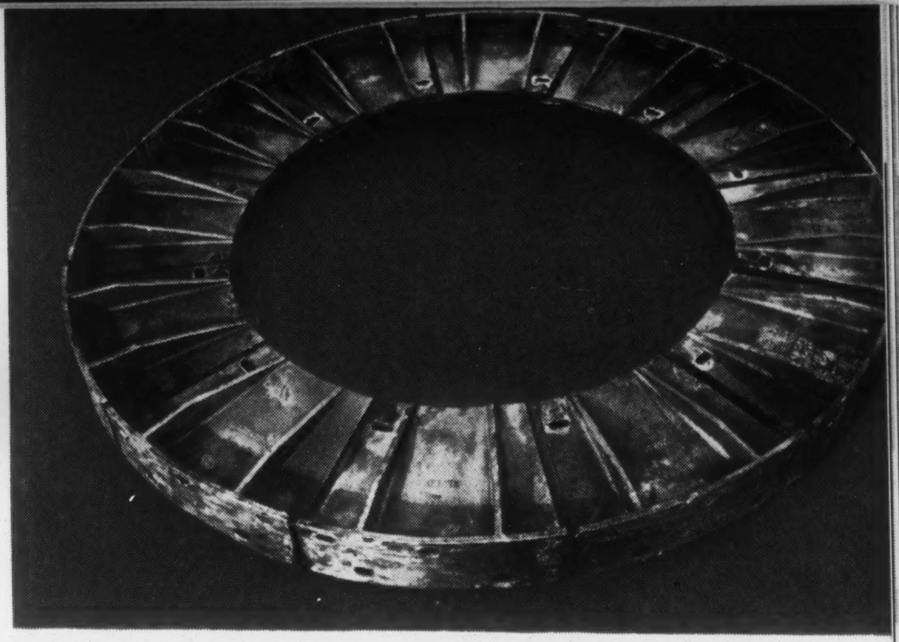
Selecting right alloy

A major consideration in selecting these alloys for equipment design is the range of expected service temperatures. In addition, the designer must know whether these temperatures are steady or cycling. Type of atmosphere—oxidizing, reducing, etc. — is equally important.

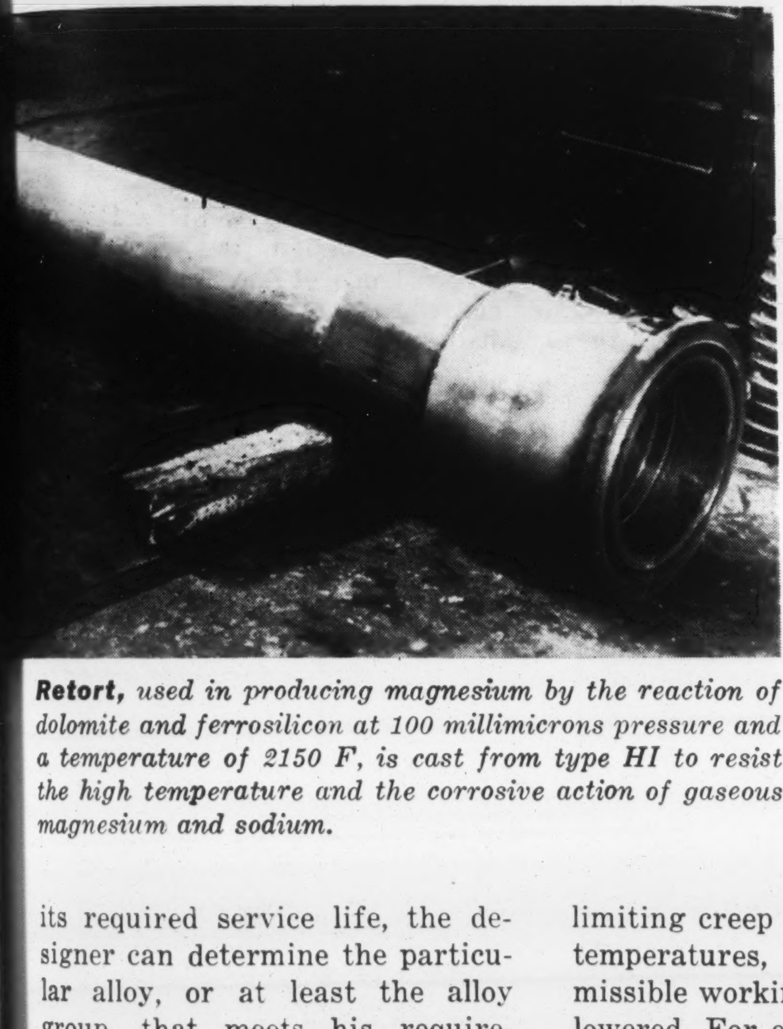
With such information, knowledge of the magnitude and type of stresses, function of the part and



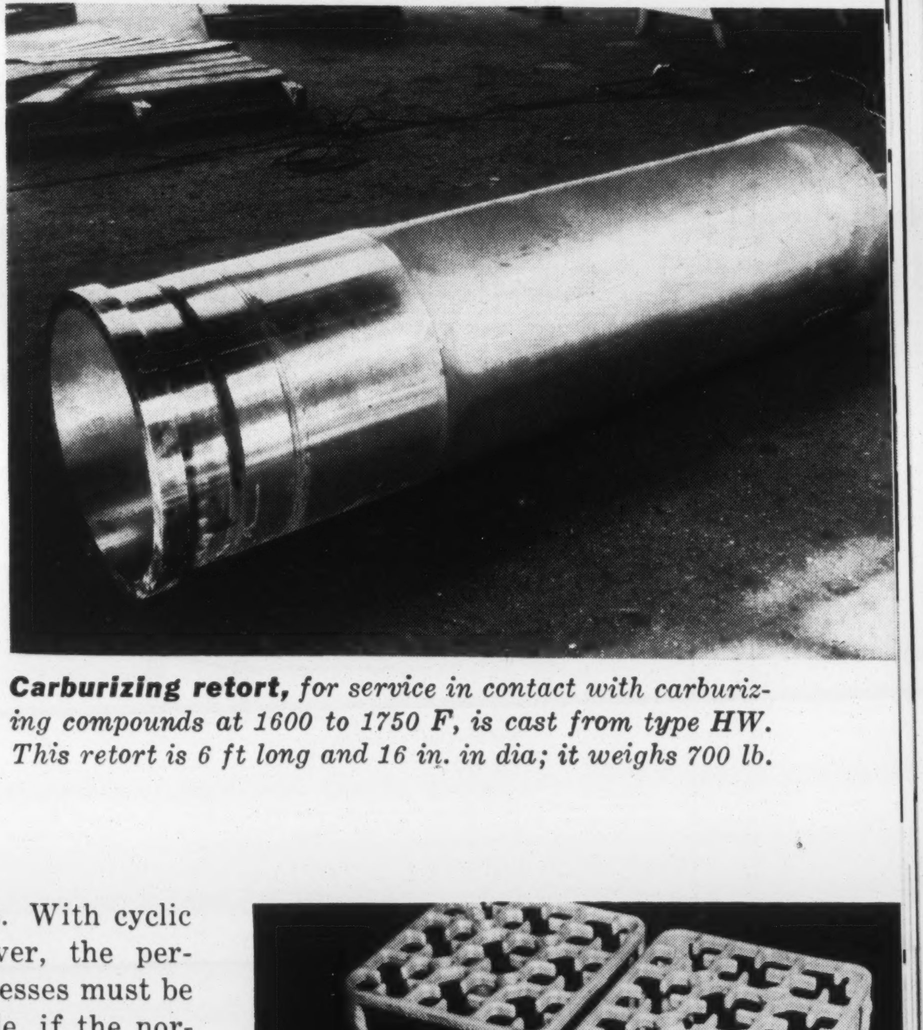
Brazing fixture *for aircraft propellers made of type HN. Operations include preheating at 1650 F for about 2 hr, heating for brazing at 2060 F for 1 hr, and cooling from brazing temperature to 600 F in 2 hr, followed by air cooling.*



Tail ring *for rotary cement kiln is cast from type HK. Segmental construction permits expansion and contraction. Service life at temperatures of 1400 to 1800 F is six years.*



Retort, *used in producing magnesium by the reaction of dolomite and ferrosilicon at 100 millimicrons pressure and a temperature of 2150 F, is cast from type HI to resist the high temperature and the corrosive action of gaseous magnesium and sodium.*



Carburizing retort, *for service in contact with carburizing compounds at 1600 to 1750 F, is cast from type HW. This retort is 6 ft long and 16 in. in dia; it weighs 700 lb.*

its required service life, the designer can determine the particular alloy, or at least the alloy group, that meets his requirements. Among the important elevated temperature properties that deserve special consideration are hot strength, thermal expansion, structural stability, corrosion resistance, resistance to thermal fatigue, and hot ductility.

Permissible design stresses vary over a wide range, and the particular value selected depends on service conditions. Many designers use a rule-of-thumb that design stresses for constant temperature service can be about 50% of the limiting creep stress. With cyclic temperatures, however, the permissible working stresses must be lowered. For example, if the normally constant temperature of a creep test is reduced to room temperature once a day, the indicated load-carrying ability of an alloy may be reduced by a factor of 10.

Other factors that must be considered are loading conditions, support of the part, and thermal gradients within the structure. Allowable design stresses should contain an experience factor, which the designer can obtain by consulting the design department of a recognized high alloy foundry.

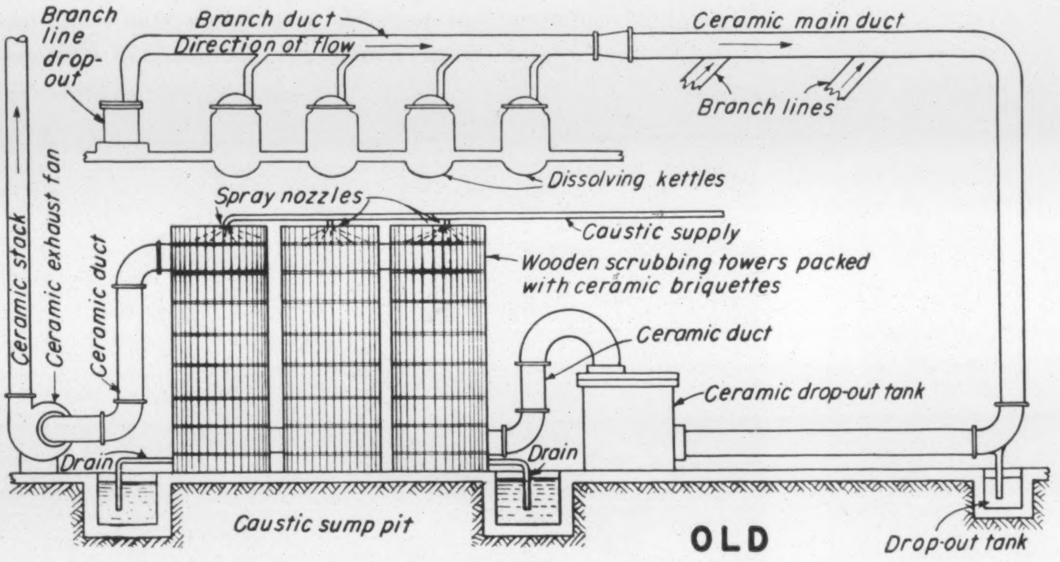
Fixtures *for use in a gas carburizing at 1700 F are cast from type HX. Each fixture holds 18 transmission shafts during carburizing, followed by martempering at 400 F.*

Toxic Fume Exhaust System Uses Ceramics, Metals, Plastics

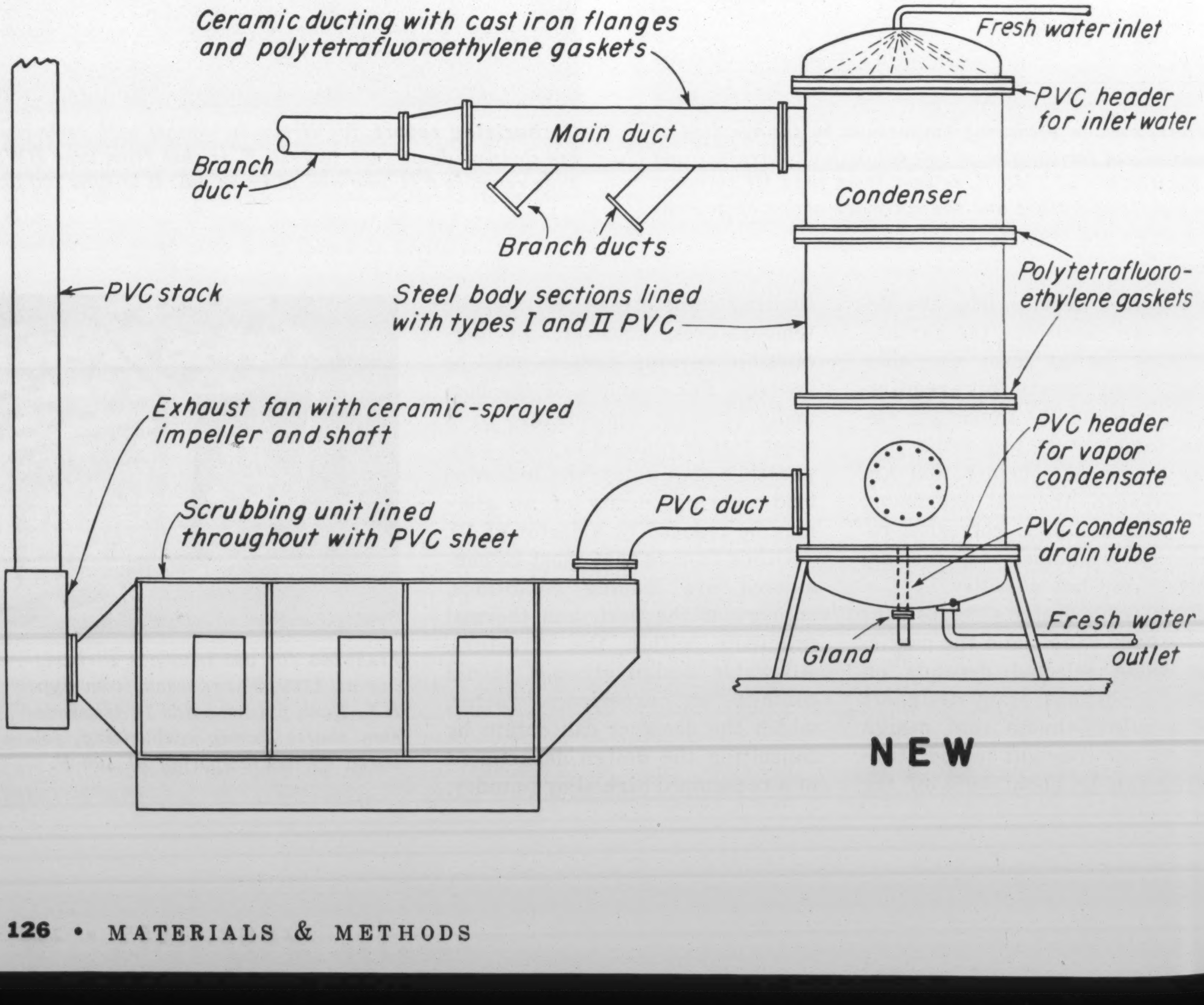
by Joseph H. Gettig

About This Article

This article is based on an entry submitted by Joseph H. Gettig for the 1957 MATERIALS & METHODS Awards Competition for the Best Use of Materials in Product Design. Because of the imaginative way in which various engineering materials were used in this redesign, the entry received one of the ten special citations awarded by the judges (see M&M, May '57).


Branch line drop-out
Branch duct
Direction of flow
Ceramic main duct
Branch lines
Dissolving kettles
Spray nozzles
Caustic supply
Wooden scrubbing towers packed with ceramic briquettes
Ceramic stack
Ceramic exhaust fan
Ceramic duct
Ceramic duct
Ceramic drop-out tank
Drain
Drain
Caustic sump pit
OLD
Drop-out tank

OLD ▲ and ▼ NEW designs of toxic fume exhaust system


Ceramic ducting with cast iron flanges and polytetrafluoroethylene gaskets
Fresh water inlet
PVC header for inlet water
Main duct
Branch duct
Branch ducts
Condenser
PVC stack
Steel body sections lined with types I and II PVC
Polytetrafluoroethylene gaskets
Exhaust fan with ceramic-sprayed impeller and shaft
PVC header for vapor condensate
Scrubbing unit lined throughout with PVC sheet
PVC duct
PVC condensate drain tube
Fresh water outlet
Gland
NEW

Handling the fumes emitted in processing precious metal ores poses critical materials problems. This article tells how redesign of a fume exhaust system using new materials has . . .

- *Increased capacity*
- *Reduced maintenance cost*
- *Provided a more flexible system*

■ Strong acid treatments are an essential operation in the processing of precious metal ores. The vapors emitted by these acid reactions must be removed for the health and safety of personnel and to prevent corrosive attack on equipment, wiring, motors, switch boxes and even exposed structural building members.

When designing for a corrosive environment of this sort the designer is limited to a narrow field of materials and selection of the proper and most efficient material for a particular part is quite difficult. Here is a summary of how some of these problems were solved in the redesign of a typical precious metal processing system.

The problem

The primary problem was to redesign the fume system so that it would be capable of collecting, scrubbing and exhausting vapors in which the most corrosive of reagents were entrained at a rate of 5000 cfm. The components and materials chosen for this system had to be capable of withstanding a combination of the following vapors for an indefinite period: hydrogen chloride, chlorine, nitric oxide, nitrogen dioxide, nitrogen tetroxide and water. Minute particles of the precious metals themselves also are entrained either as finely divided particles or in solution.

In addition, means had to be provided for cooling the vapors to room temperature and reducing their volume before scrubbing. This was important for several reasons. By reducing the volume of the vapors, the volume of neutralizing liquids in the scrubber could be reduced to such a point that the liquids could be recirculated and filtered, and the entrained metals recovered. Recirculation would also permit installation of a system for automatic pH control.

Furthermore, by operating the system at room temperature, acid-resistant plastic materials might be used in the scrubber units with no sacrifice in their structural strength. Use of easily assembled plastic ducting would also permit limited rearrangement of equipment to suit process changes.

Because of the large volume of solution and fumes that were handled, filtering and reclaiming proved to be impractical and consequently metal losses ran high. The system was designed to handle 1500 cfm of fumes. Increased productivity only produced higher metal losses, increased the waste of water and caustic, and rendered the already inefficient fume system practically useless. Because of space limitations and the size of the scrubbing towers, addition of enough extra units to meet higher production requirements was out of the question. Also, increasing the volume and velocity of the ladened atmosphere meant that fumes would reach the scrubbing unit at overly high tempeartures of the order of 130 to 150 F.

The old design

The former installation that handled the fumes consisted of a series of duct lines composed of molded lengths of ceramic tile with male and female sleeve connections. This tile was similar to terra cotta sewer tile, but had longer female sleeves. Since a self-setting, acid-resistant fiber mastic was required to seal each joint, the system did not lend itself to easy disassembly and rearrangement.

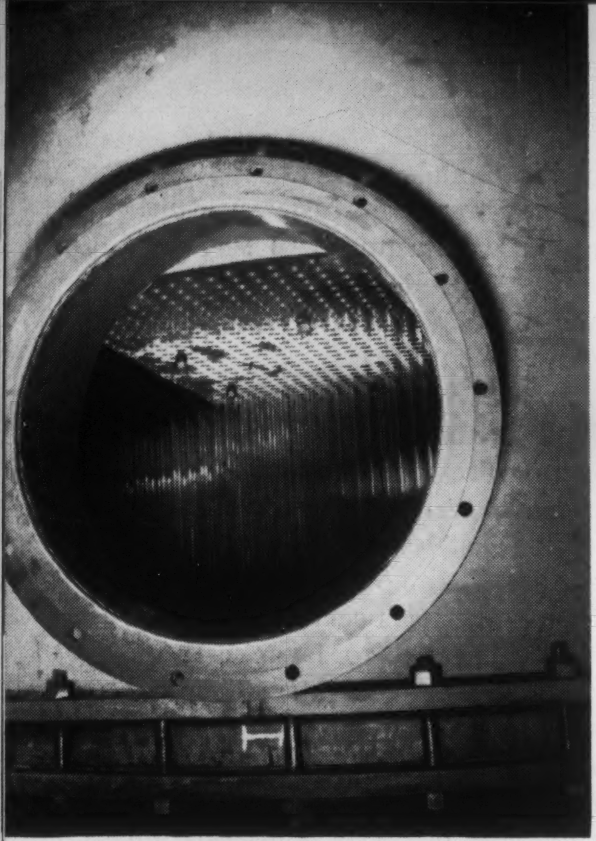
As shown in the accompanying sketch of the old design, all branch ducts were mounted on an angle of slope terminating in the dissolving kettles or in closed condensate drop-out pots. Each branch duct was served by a main duct connected to large ceramic drop-out pots. The large drop-out pots were ducted to a fume scrubber consisting of three cylindrical wooden towers, treated inside and out with acid-resistant mastic. Each cylinder was headed at both ends and packed with molded cellular ceramic briquettes. The towers were interconnected so that vapor flow alternated from bottom to top and the last tower was ducted to the atmosphere through an intermediate ceramic exhaust fan.

One of the biggest bottlenecks in the scrubbing network was created by the alkaline solution used to neutralize the acid fumes. This solution was sprayed at the top of each tower and from there flowed to a large catch basin where it accumulated until the pool was full. The pH of the solution was manually controlled.

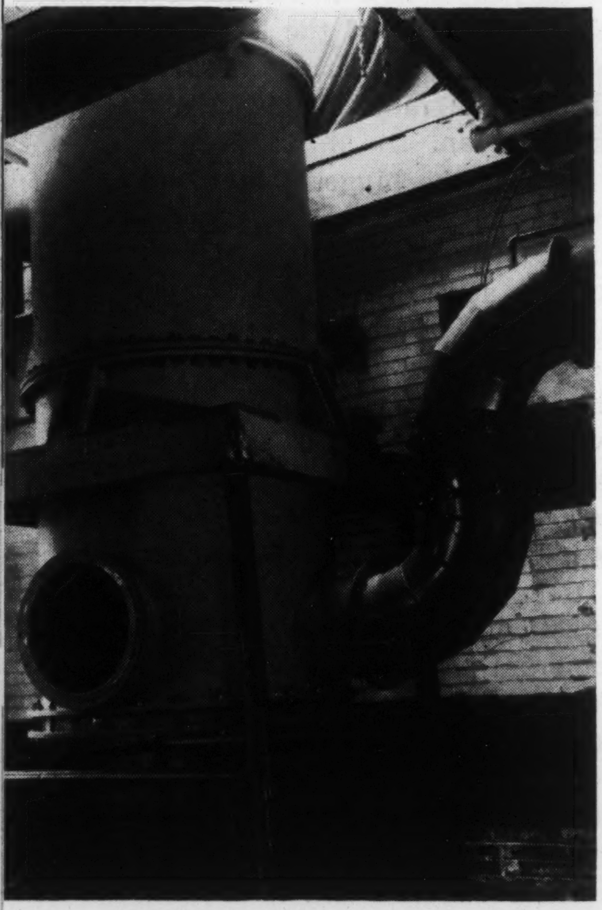
Materials in redesign

Condensing unit—The primary function of this unit is to cool all vapors to room temperature before they enter the scrubber and to collect any vapors that may be condensed during the cooling process. As shown in the photographs (next page), the form of the condensing unit is similar to that of a water tube heat exchanger. The vertical steel shell is made up of two steel body sections and two domed end sections, all of which are separated by polytetrafluorethylene (Teflon) gaskets. The vapors pass from the main duct at the top body section, through the unit, and out of the lower body section to the scrubber.

The shell is lined throughout with a duplex lining consisting of Types I and II polyvinlchloride



Body shell *of new condenser system (domed ends not shown) with inlet and outlet vapor ducts connected. Opening at lower left is for access to interior of unit.*



Interior view *of condenser unit showing borosilicate glass water tubes and polyvinyl chloride vapor baffle.*

(PVC). Type I PVC is cemented directly to the steel shell because of its excellent adhesion properties and Type II PVC is used as the outer layer because of its higher heat strength and superior resistance to corrosive atmospheres.

The main body shells are separated from the end domes by means of 2-in. thick, Type I PVC plates. Cooling water enters the unit at the upper dome, collects on the upper PVC plate and passes downward through 1250, ¾-in. borosilicate glass tubes with a 3/32-in. wall. The tubes pass through the lower PVC plate and the water exhausts into the lower bowl section where it is returned to a cooling tower for recirculation.

Very good heat transfer is obtained since the water drains down through the inside walls of the tubes as a film and not as a water column. The upper and lower domes contaning the water are sealed from the main body section by filling the space between the glass tubes and the PVC plates with tapered, tubular chlorosulfonated polyethylene (Hypalon) packing.

All condensed vapors are collected on top of the lower PVC plate. A PVC tube, running from the center of this plate and through the lower bowl section is used to drain the condensate. The upper end of this tube is threaded into the plate to prevent condensate leakage into the lower bowl section containing the cooling water. The lower end is provided with a packing gland to prevent leakage of water out of the bowl.

Scrubbing unit—The redesigned scrubbing cabinet is much the same as that used in air conditioning equipment with the exception that it is lined throughout with PVC sheet, cemented in place and welded at all joints. PVC is also used for the filter frames, racks, bolts, all inside supporting members and on the stainless steel spray nozzles.

Glass wool is now used as a filter material and it is packed in 3 x 10 x 15 in. removable cartridges. The entire scrubbing unit occupies a space 2½ ft wide, 8 ft high and 15 ft long, including inlet and outlet transition. The unit readily fits in the area formerly occupied by the packed towers with plenty of room to spare.

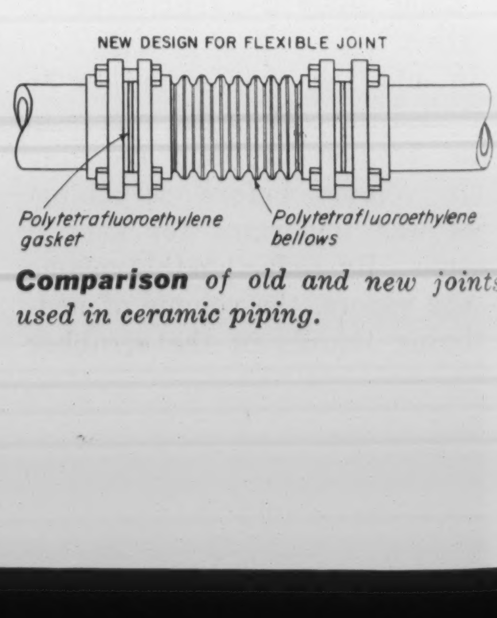
Conducting system—To facilitate disassembly and rearrangement of the piping system, all major branches and the main duct line piping were redesigned using ceramic pipe with cast iron flanges. The flanges are ground square and are separated by a ¼-in. polytetrafluoroethylene gasket prior to bolting (see sketch). Line losses with this system have been completely eliminated.

In addition, flanged and bolted PVC duct piping is now used between the condenser and scrubber and from the exhaust fan to the stack. The 60-ft stack is fabricated from PVC. Also, the impeller and shaft of the exhaust fan are protected with a PVC compound. This fan is connected directly to the scrubber unit by a metal duct which is also lined with PVC.

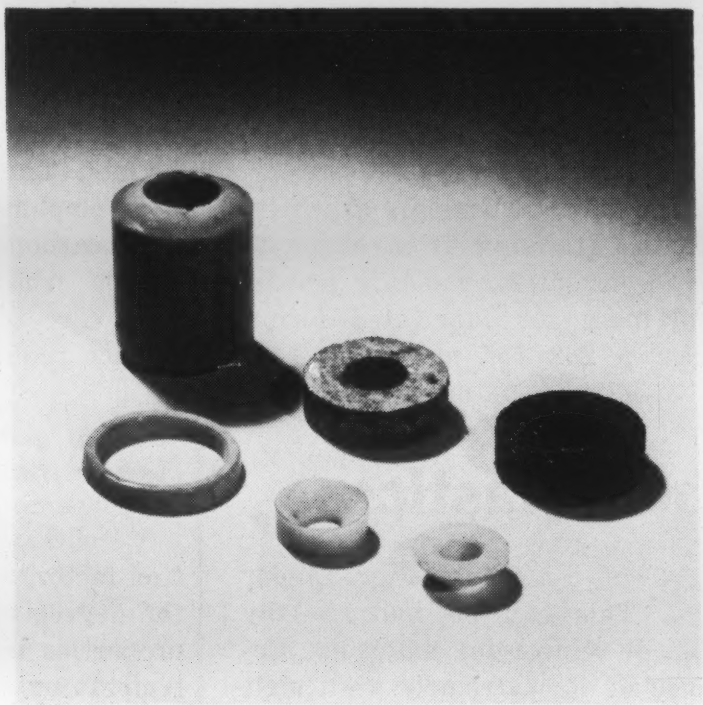
The results

All of the above materials were chosen for their resistance to corrosive vapors encountered in this system. The materials have performed effectively for eight months with no visible signs of deterioration.

The cost of the entire system compares favorably with systems fabricated largely of metals, and is calculated to be about $2.50 per lb. It has been conservatively estimated that maintenance costs alone will be reduced 60% through the prevention of equipment and wiring corrosion.

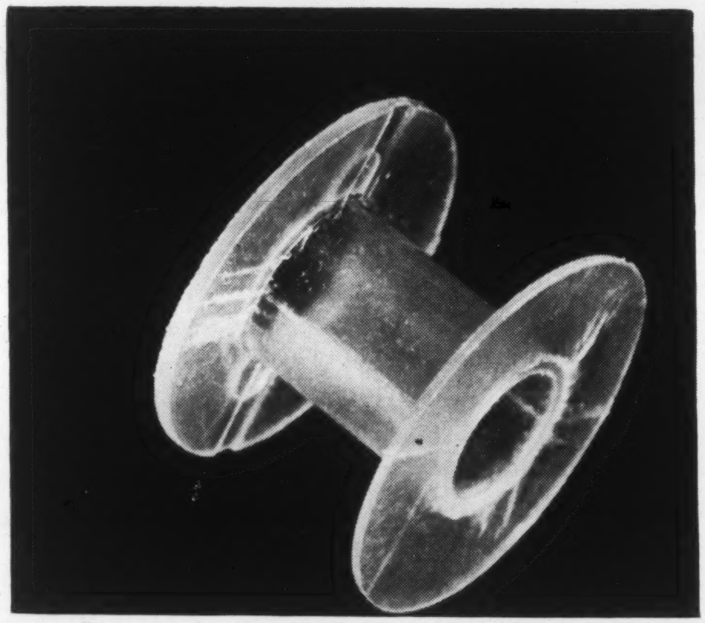

OLD DESIGN
Ceramic pipe
Self-setting mastic joint sealer
NEW DESIGN
Ceramic pipe
Cast iron flanged joints
Polytetrafluoroethylene gasket
NEW DESIGN FOR FLEXIBLE JOINT
Polytetrafluoroethylene gasket
Polytetrafluoroethylene bellows

Comparison *of old and new joints used in ceramic piping.*



Excellent chemical resistance

High thermal stability



Good electrical properties

Nonstick surface

These favorable properties are the reason why, despite the high cost of these materials, the design engineer should become familiar with the latest information on the . . .

Selection and Design of Fluorocarbon Plastics

by **Malcolm W. Riley,** *Associate Editor, Materials & Methods*

MATERIALS & METHODS MANUAL NO. 138—JUNE 1957

■ The combination of properties that has made fluorocarbon plastics so useful to the design engineer is: 1) inertness to almost all chemicals, 2) resistance to both high and low temperatures, 3) excellent dielectric properties, 4) zero moisture absorption, for all practical purposes, 5) high impact strength, and 6) a nonstick surface with low coefficient of friction. In most applications, selection of fluorocarbon plastics is based on a need for a combination of two or more of these.

The fluorocarbons are expensive plastics, ranging from about $4 to $8 per lb for molding powder and more for fabricated forms. (See p 232 for more detail on costs). However, as is the case with any engineering material, materials costs are secondary when design requirements must be met. The cost of the materials does emphasize the fact that the fluorocarbons are specialized materials which must be selected with care for applications where service requirements are critical.

Types of Fluorocarbon Plastics

There are two basic types of fluorocarbon plastics: TFE (tetrafluoroethylene) and CFE (chlorotrifluoroethylene). TFE is a perfluorocarbon, i. e., the molecule consists entirely of carbon and fluorine atoms. In CFE, one out of every four fluorine atoms has been replaced with a chlorine atom. Fluorine provides the resins with chemical and thermal stability; chlorine provides melt flow characteristics, and greater rigidity at room temperature. Thus, in general, characteristics of the two materials can be summarized.

TFE is inert to most chemical reagents and solvents, has high thermal stability, and has constant dielectric properties over a wide range of frequencies and temperatures. It has the lowest coefficient of friction of any known solid material. In the unfilled condition it has fair mechanical strength and high impact strength, but relatively poor resistance to deformation under load. This can be improved by filler or reinforcing materials. Because of its extremely high melt viscosity (it becomes a gel at the transition temperature), it cannot be formed by conventional thermoplastic molding techniques, but must be molded or extruded by techniques resembling those used for powder metallurgy. It can also be applied as a dispersion coating.

CFE can be formed by somewhat more conventional molding methods similar to those used for thermoplastics. It has higher tensile strength, resistance to deformation under load and flexural modulus at room temperature than TFE. For applications where greater flexibility is required at the sacrifice of some heat and solvent resistance, plasticized CFE can be specified. Dielectric properties are extremely good, though they do not measure up to those of TFE, particularly in dissipation factor, dielectric constant and the degree of sensitivity of these properties to high frequency and temperatures. Depending on processing variables, optical clarity can be obtained in relatively thin sections. Because of the chlorine content of CFE, chemical, dielectric and thermal stability are sacrificed somewhat in comparison with TFE. CFE can also be applied as a dispersion coating.

In selecting the proper type and grade of fluorocarbon plastic for a specific application, both the properties and the design and production characteristics of the materials must be considered. Compromises must be made in many cases. This article is divided into two parts: 1) comparative properties, and 2) comparative design and fabrication factors. Both groups of factors must be considered in selection of fluorocarbon plastics.

Specific Properties: TFE vs CFE

Before comparing the specific properties of the two types of fluorocarbons in detail, the design engineer should understand the general effect of crystallinity of the polymer on its properties. Though with other plastics this is normally unnecessary, in the case of fluorocarbons the effect is so critical that a general discussion is warranted.

Crystallinity vs properties

Both TFE and CFE are crystallizable polymers. The size, amount and arrangement of crystals determine many of the properties of the material, such as stiffnes, dimensional stability, flex life, permeability and transparency. Properties inherent in the chemical structure of the polymers and relatively independent of crystallinity include thermal and chemical resistance, dielectric properties and the nonstick characteristics.

Specific data on the effect of crystallinity on properties are relatively new. Several of the accompanying graphs show these effects. However, these data should be used judiciously, since their purpose is only to indicate effects of ranges of crystalline content. Crystallinity is a function of molecular weight and temperature. The rate at which a part is cooled after processing controls to a great extent the number and size of the crystalline spherulites allowed to form in the material. If the part is quenched rapidly from

Fluorocarbon Resins

- **What to call them**
- **Who makes them**

The chemical names of the fluorocarbon plastics are tongue-twisters: polytetrafluoroethylene and polychlorotrifluoroethylene. Because the names are long and could be confusing the two resins in this article are referred to as TFE, for tetrafluoroethylene, and CFE, for chlorotrifluoroethylene. Though both materials are used in polymer form, the logical P for poly- has been dropped, again to simplify terminology.

TFE is produced by one company only:

E. I. du Pont de Nemours & Co., Inc. . . . Teflon

Three companies produce CFE at present, and a fourth is now in pilot plant production. The four companies and the trade marks for their respective materials are:

Minnesota Mining and Mfg. Co., Jersey City Chemical Div. . . . Kel-F

Bakelite Co., Div. of Union Carbide Corp. . . . Fluorothene[a]

Acme Resin Corp. . . . Polyfluoron

Allied Chemical & Dye Corp., General Chemical Div. (pilot plant). . . . Genitron HL

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[a] Fluorothene is not a registered trademark.

processing temperatures very few spherulites have time to form, and the material is relatively amorphous. In this condition it has maximum light transmission, clarity and flexibility, and usually somewhat low tensile properties. Slower cooling permits larger crystals to grow, providing higher levels of crystallinity and thereby lowering light transmission, raising tensile properties and producing a more rigid material with higher flexural modulus.

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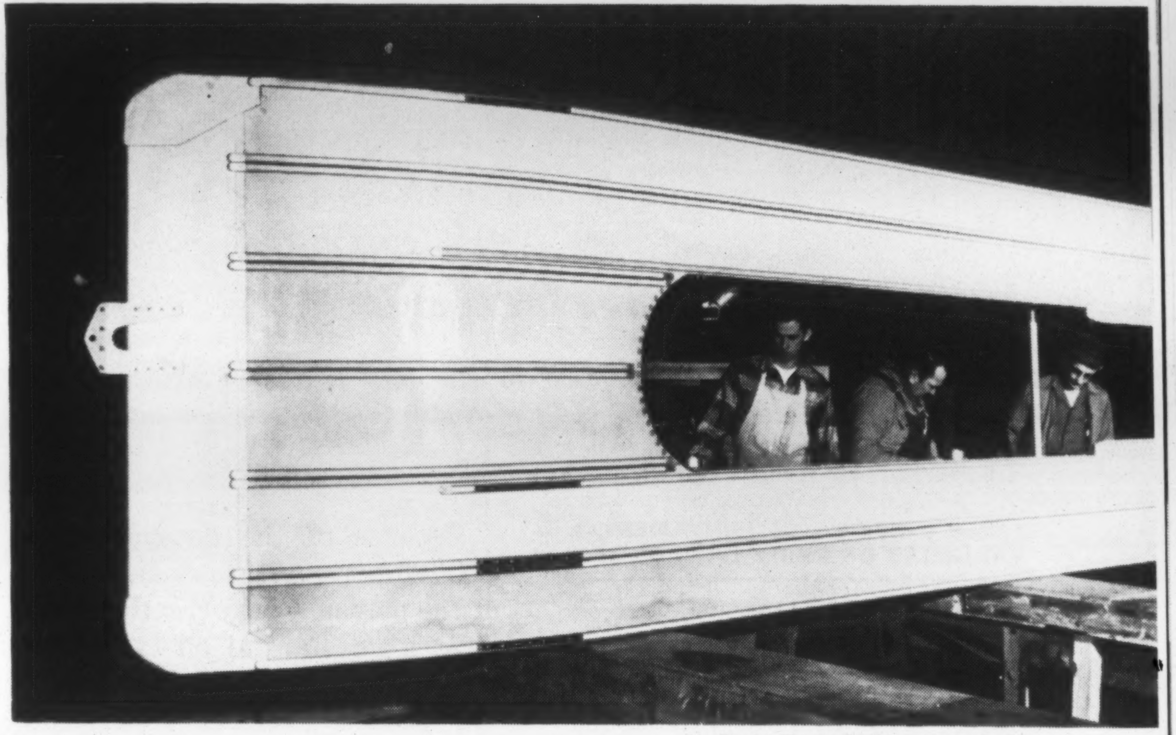
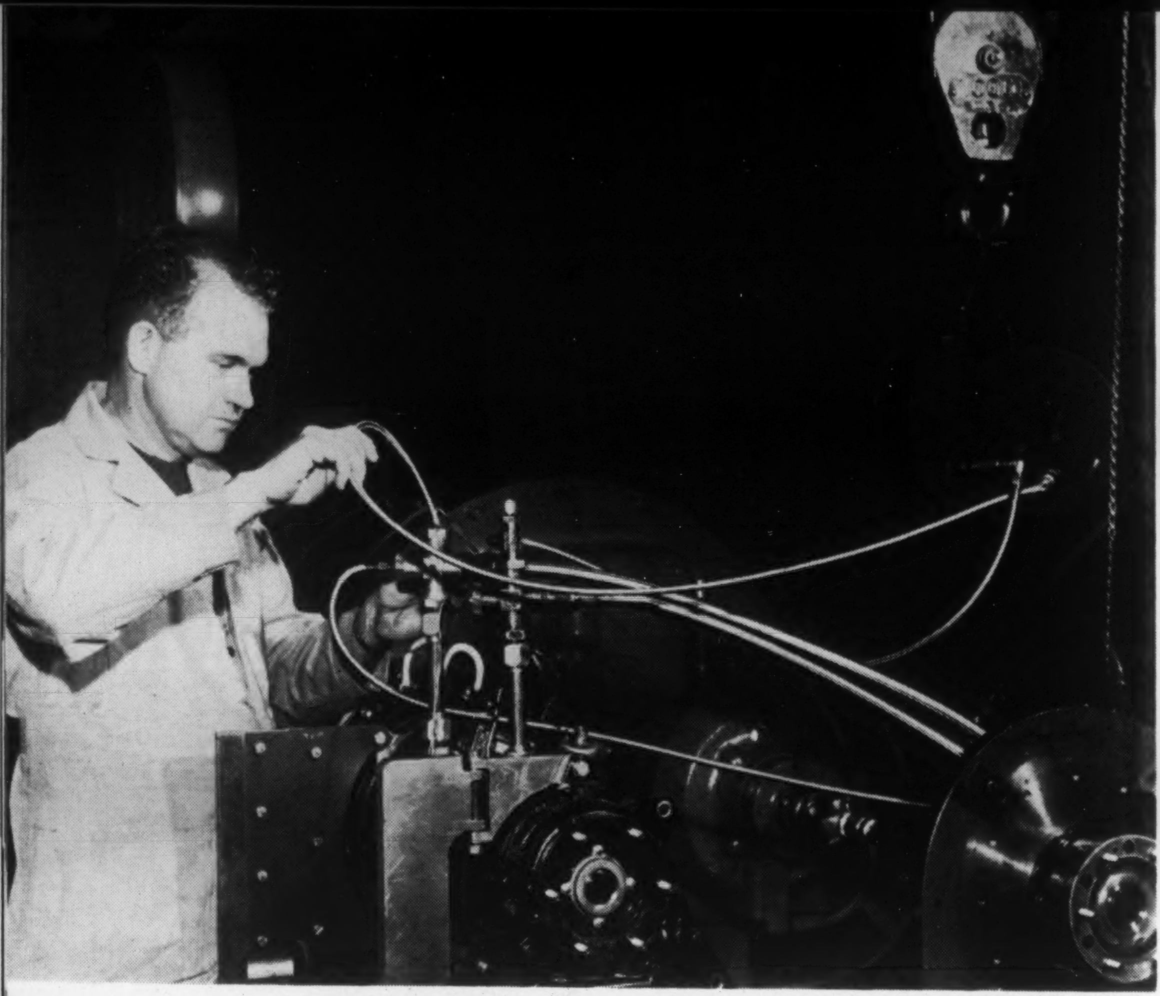


E. I. du Pont de Nemours & Co.

Aircraft skis *for the Lockheed C-130 are coated with a thin film of TFE (bottom) to prevent sticking to snow and ice during polar service.*

Minnesota Mining and Mfg. Co.

End bearings *for rotating metal plating racks are made of CFE to prevent shaft seizing and eliminate need for lubrication.*



Resistoflex Corp.

Reinforced hose *of TFE is used to circulate synthetic hydraulic fluid at temperatures up to 250-350 F in Sundstrand Aviation's equipment for testing hydraulic, constant-speed drives.*

Because of the dependency of crystallinity on thermal history of the polymer, heat treatment can have a substantial effect on end properties. In addition to annealing strains from the material, carefully controlled heat treatment can stimulate crystal growth, altering the properties substantially. However, even with the additional control of crystallinity available through heat treatment, exact crystallinity levels cannot be specified. Fluorocarbons, in common with other plastics, have low thermal conductivity which limits the degree of control over crystallinity possible on core areas of thicker sections. For example, CFE parts thicker than 1/16 in. are always somewhat crystalline in the core areas. In general, control of crystallinity in thin sections is limited mostly by manufacturing costs, i. e., cycle times, which determine the degree of control over cooling rates and subsequent heat treatments that is permissible. Control of crystallinity in thick sections is limited by heat transfer characteristics of the fabricated part.

The above, of course, is a simplified explanation. In addition to crystallinity and molecular weight, void content affects electrical and physical properties of the product. The relative influence of these variables is illustrated in Table 1, which shows the effects on several properties of TFE of increasing the three parameters.

Because of the complex relationships among end properties, fabricating methods and heat treatment techniques, the design engineer should work closely with a processor of fluorocarbons in the initial design stage. The processor's experience can be of invaluable assistance in developing

TABLE 1—EFFECT OF FUNDAMENTAL VARIABLES ON PROPERTIES OF TFE

Property	Maximum Change Due to Increase in:		
	Molecular Weight	Crystallinity	Void Content
Flex Fatigue Life	+100-fold	−100-fold	−1000-fold
Compr Str at 1% Defl	0	+50%	0
Compressibility	0	−50%	—
Recovery	0	−70%	—
Permeability to CO_2	0	−30-fold	+1000-fold
Flexural Modulus	0	+5-fold	−30%
Hardness			
Durometer	0	+20%	—
Rockwell	0	−20%	−30%
Scleroscope	0	−70%	−10%
Tensile Impact Strength	0	−15-fold	−80%
Dielectric Strength	0	0	−70%
Proportional Limit	0	+80%	−20%
Yield Stress	0	+15%	−20%
Yield Strain	0	−15-fold	0
Tensile Strength	+25%	−50%	−50%
Ultimate Strength	+50%	−70%	−50%
Ultimate Elongation	−20%	+100%[a]	−80%

[a] Reaches a maximum at 85% crystallinity; drops to 1/10 of maximum above 85% crystallinity.

TABLE 2—TYPICAL PHYSICAL AND MECHANICAL PROPERTIES OF FLUOROCARBON PLASTICS

Property ▼	TFE (Tetrafluoroethylene)		CFE (Chlorotrifluoroethylene)	
	General Purpose Molding Grade[a] (50-56% crystallinity)	Extrusion Grade[b] (50-82% crystallinity)	Unplasticized	Plasticized (25%)
Specific Gravity	2.13-2.15	2.15-2.25	2.1	2.1
Tensile Strength, psi	2800-2300[c]	4200-2000[c]	4500-6000[d]	2700-3000[d]
Ultimate Elongation, %	250-180	380-800	125-175	250-300
Proportional Limit, psi	1200-1300	1100-1800	3000-3500	—
Yield Stress, psi	1800-2000[c]	1600-1800[c]	4200	1500
Yield Strain, %	70	60-9	10	—
Flexural Modulus, psi	62,000-74,000	54,000-170,000	175,000	16,000
Compressive Modulus, psi	70,000-90,000	—	180,000	—
Flex Life, cycles	60,000-40,000	>7,000,000-1000	—	—
Impact Strength (Izod), ft-lb/in. notch	3.0	—	3.6-4.0	20
Durometer Hardness (Shore D)	53	—	77-80	53-55

[a] Teflon "1."
[b] Teflon "6."
[c] Microtensile specimens of $\frac{3}{16}$ x $\frac{1}{16}$ x $\frac{7}{8}$-in. gage length. Crosshead speed: 5 ipm.
[d] ASTM D638-52T; crosshead speed 1 ipm.

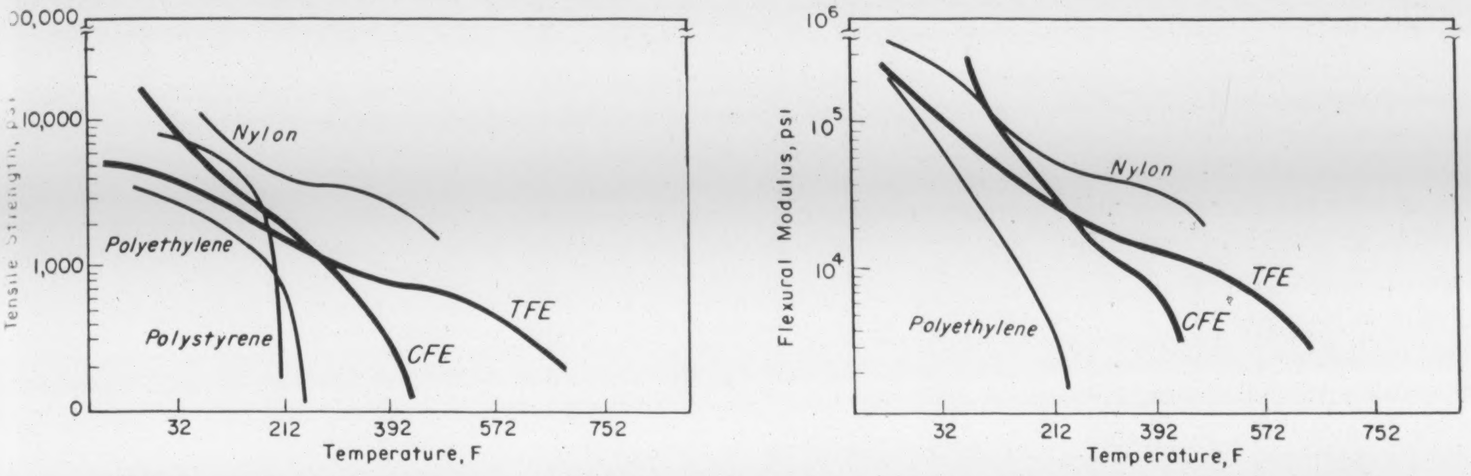
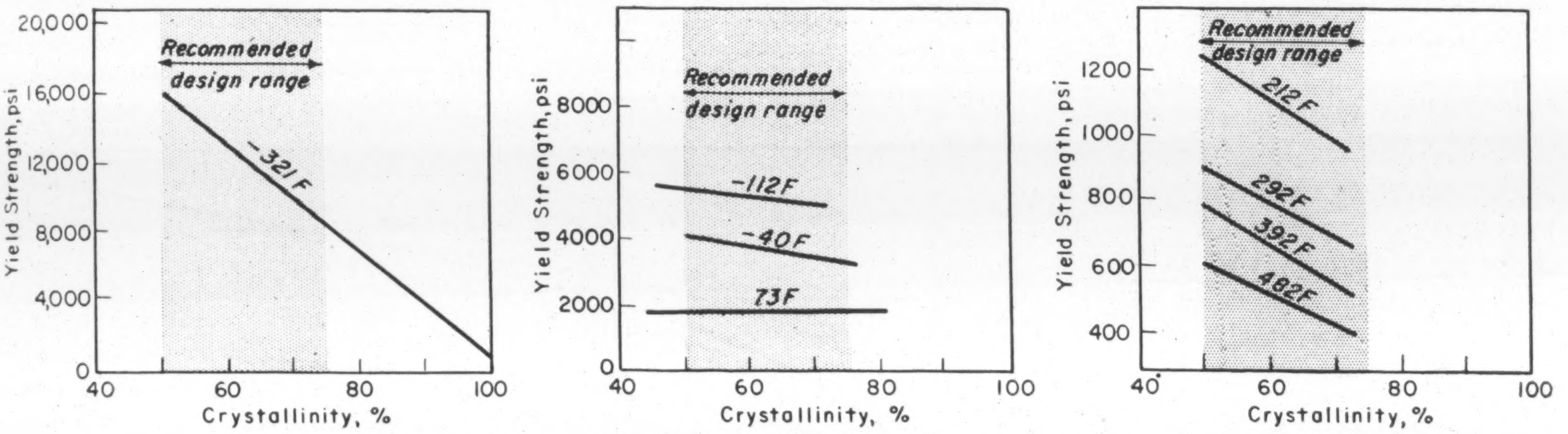
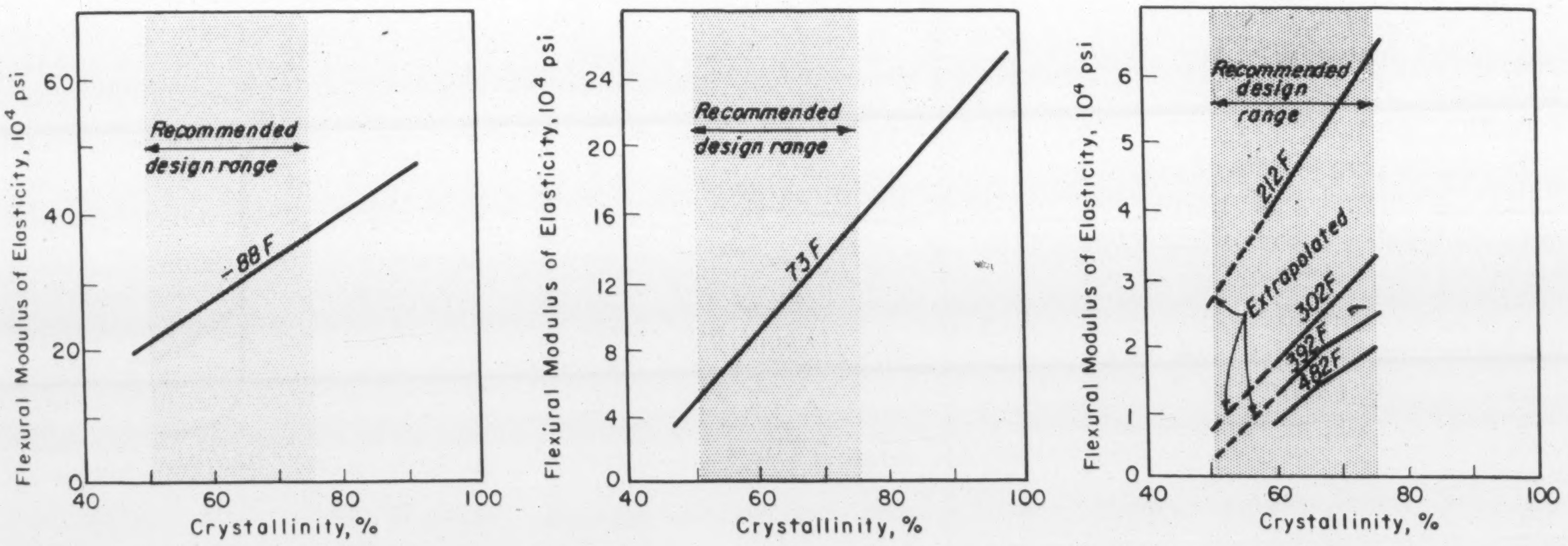


Fig 1—*Effect of temperature on tensile and flexural properties of fluorocarbon and other plastics.*

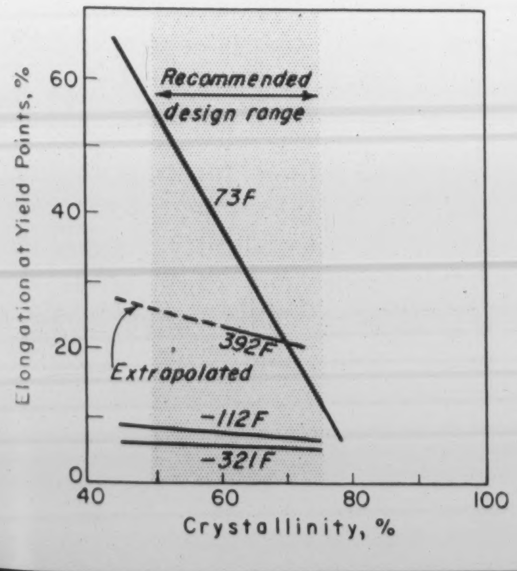
Fig 2—Effect of TFE's crystallinity on . . .



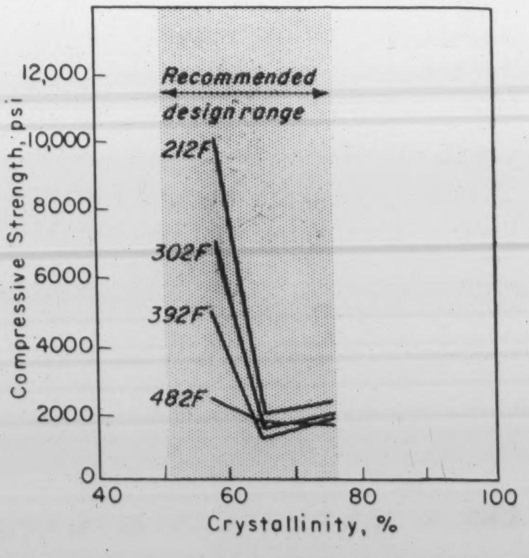
Yield strength *at various temperatures.*



Flexural modulus *of elasticity at various temperatures.*



Elongation *at yield point.*



Compressive strength.

realistic design specifications and modifying the actual design to obtain the best possible result.

The following sections compare specific properties of TFE with those of CFE, and include discussions of effects of crystallinity and both high and low temperatures on these properties.

Mechanical properties

Typical mechanical properties of 1) two grades of TFE prepared by different methods to provide different crystallinity levels, and 2) unplasticized and plasticized CFE are given in Table 2. The range of properties given for CFE in each case is the spread obtained over a range of crystallinity.

Mechanical strength and resistance to deformation under load of CFE are somewhat better than those of unfilled TFE at room temperature. With increasing temperature, the tensile strengths of both materials decrease, the decrease in strength of CFE being more rapid than that of TFE. At temperatures above about 250 F TFE retains more tensile strength than CFE. Fig 1 shows how temperature affects the tensile strength and flexural modulus of fluorocarbons in comparison with nylon, polystyrene and polyethylene. CFE has no strength above about 390 F and TFE has little strength above 600 F.

In considering effects of crystallinity on mechanical properties, data on TFE are somewhat more complete than on CFE. The curves in Fig 2 show the effect of crystallinity on compressive and yield strength, yield strain and flexural modulus of TFE at various service temperatures. The graphs also show the general range of crystallinity recommended for design purposes, i. e., 50-75%. Safety factors are not included and should be applied subject to the judgment of the design engineer. As mentioned earlier, control of crystallinity in thin sections is limited mostly by manufacturing costs and in thick sections by the heat transfer characteristics of the fabricated part.

TABLE 3—EFFECT OF CRYSTALLINITY ON MECHANICAL PROPERTIES OF CFE[a]

Type ➤	Low Crystallinity (quenched)		High Crystallinity (annealed)	
Property ➤	Yield	Fracture	Yield	Fracture
COMPRESSION MOLDED (0.040-in. sheets)				
Tensile Strength, psi				
73 F	4180	4800	5600	5300
122 F	2160	2700	3800	4000
212 F	430	630	—	—
Elongation, %				
73 F	8	90	6	24
122 F	17	>150	10	140
212 F	20	>150	—	—
Modulus of Elasticity, psi				
73 F	215,000		275,000	
122 F	130,000		220,000	
212 F	5000		—	
INJECTION MOLDED				
Tensile Strength (73 F), psi	5800-6800			
Elongation (73 F), %	5.0-13.5			
Flexural Strength (73 F), psi	7500-9000			
Modulus of Elasticity (73 F), psi	200,000-270,000			

[a] Testing speed: 0.1 ipm below yield point; 1.0 ipm above yield point.

Source: *Bakelite Fluorothene Resins,* Technical Data, Feb '55, Bakelite Co., Div., Union Carbide Corp.

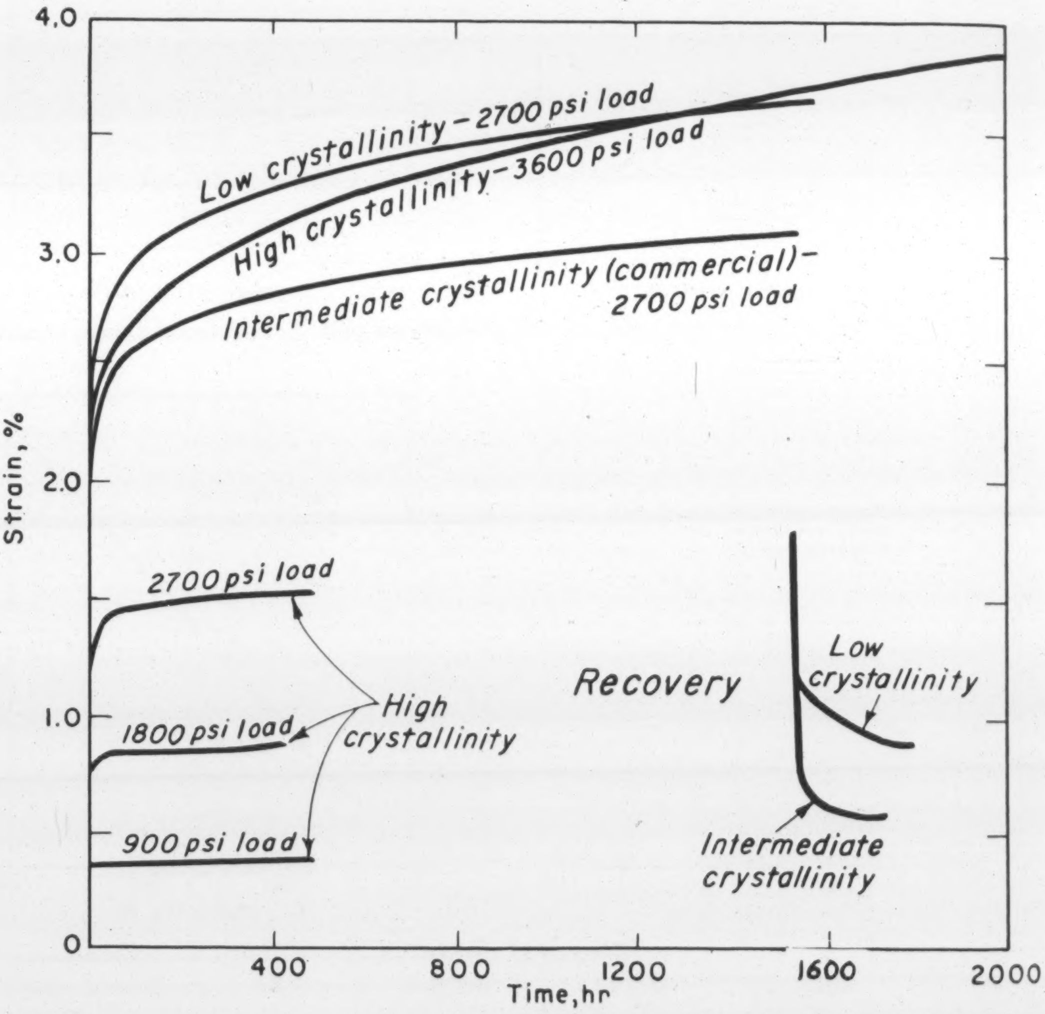
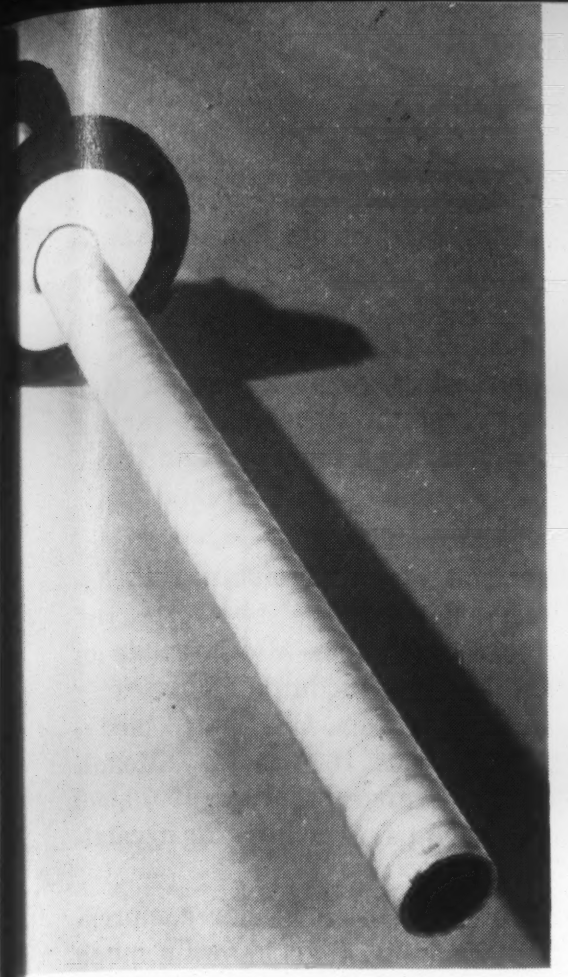


Fig 3—*Effect of crystallinity on creep and recovery characteristics of CFE at various load levels.* (*W. N. Findley, Brown University*)

Effects of crystallinity on CFE at various service temperatures are shown in Table 3. Values are given for compression molded samples, which permit greater control over cooling rate, and for injection molded samples. Quenched values for compression molded samples represent low levels of crystallinity; annealed values represent high levels of crystallinity. This range is generally obtainable with extruded



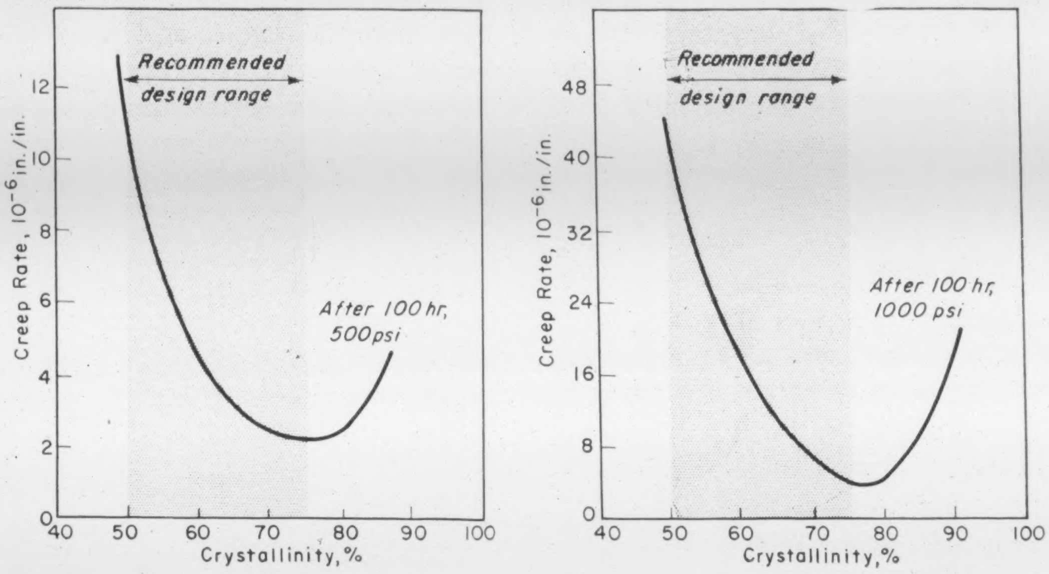
Resistoflex Corp.

Dip pipes *made of TFE-impregnated glass cloth are fracture proof and chemically inert.*

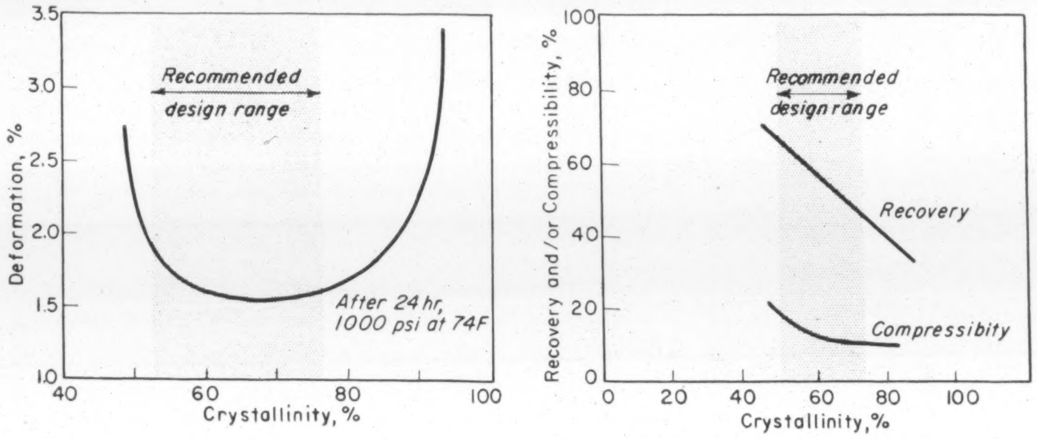
CFE as well. Values for injection molded samples represent the range obtainable by altering temperature control as much as is commensurate with good injection molding practise.

Creep—Resistance to creep or cold flow (permanent deformation occurring with time in stressed parts) is particularly important in applications such as gaskets or seal rings. CFE, with better creep resistance than TFE, is more resistant to such deformation at temperatures up to about 250 F. Creep data for CFE under tensile loading are shown in Fig 3 at three different levels of crystallinity and at various stress levels. As would be expected, for a given load, creep is inversely proportional to the degree of crystallinity. Under small loads, an equilibrium state is reached quickly. Under larger loads, creep continues slowly for hundreds of hours, following an initially large displacement. Most of the deformation is rapidly recovered after the load is removed, showing that the greater part of the original deformation is elastic. Above the yield point, almost all the defor-

Fig 4—Effect of TFE's crystallinity on . . .



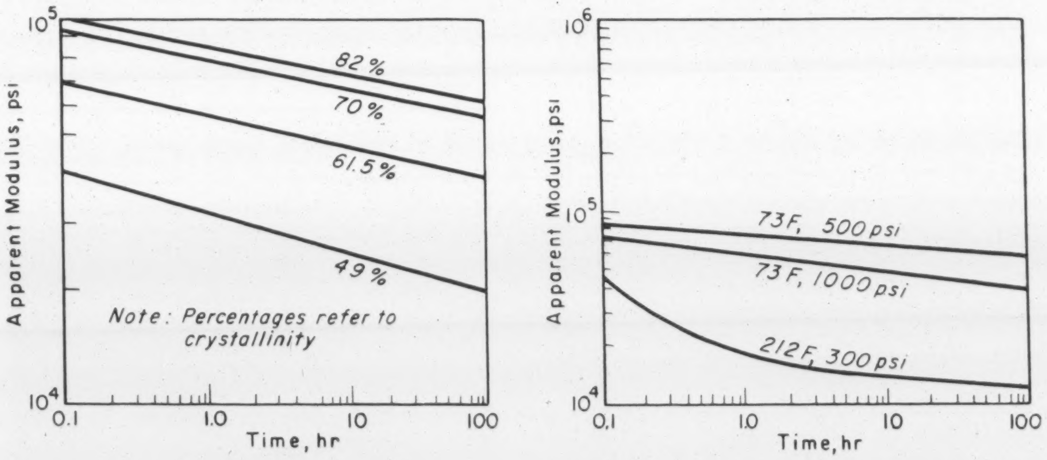
Creep rate *at various loadings.*



Deformation.

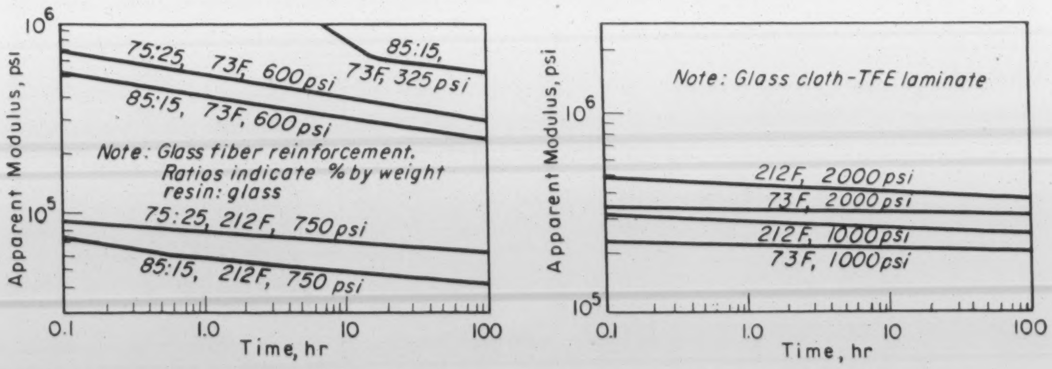
Compressibility *and recovery.*

Fig 5—TFE's apparent modulus vs time: effect of . . .



Various crystallinity levels.

Various loads *and temperatures.*



Reinforcement *with glass fiber.*

Temperature *on glass laminate.*

mation is nonrecoverable, i. e., plastic flow.

The effect of crystallinity on cold flow of TFE under compressive loading is shown in Fig 4. The curves show effect of crystallinity on deformation under a 1000-psi load, on creep rate under two different loads, and on compressibility and recovery characteristics. The resistance of TFE to cold flow can be improved substantially by use of fillers. The effect of glass fiber and glass cloth in improving cold flow resistance of TFE is shown in Fig 5. The series of curves shows apparent modulus (a convenient method of expressing creep) vs time at various crystallinity levels, at various temperatures, and for resins reinforced with glass fiber and cloth.

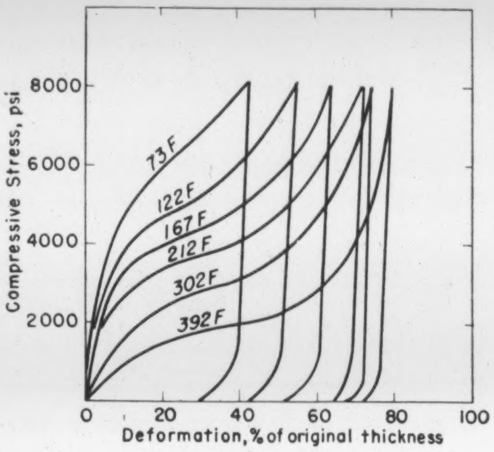


Fig 6—*Deformation and recovery characteristics of TFE at various temperatures.*

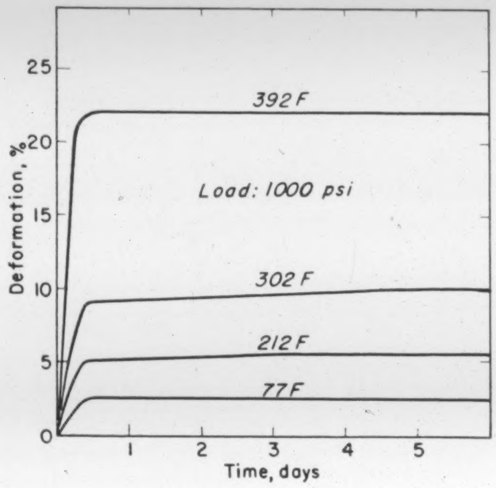


Fig 7—*Deformation vs time for TFE under 1000 psi load at various temperatures.*

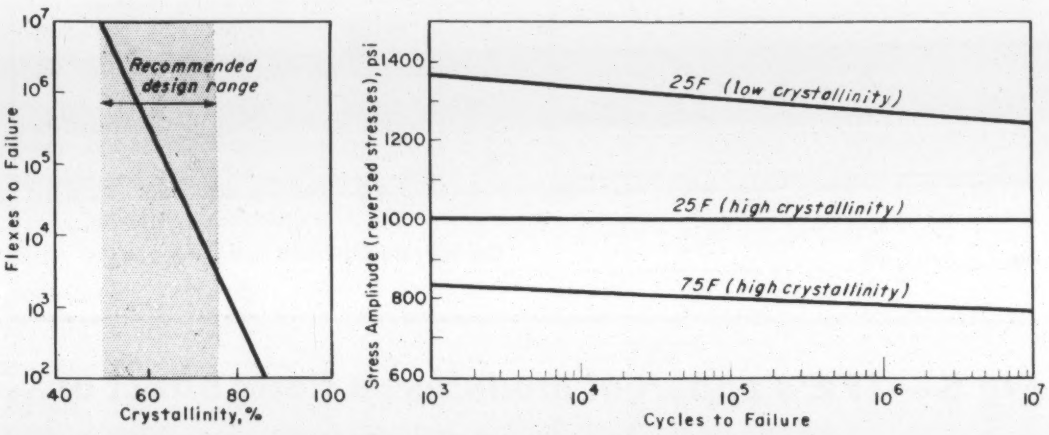
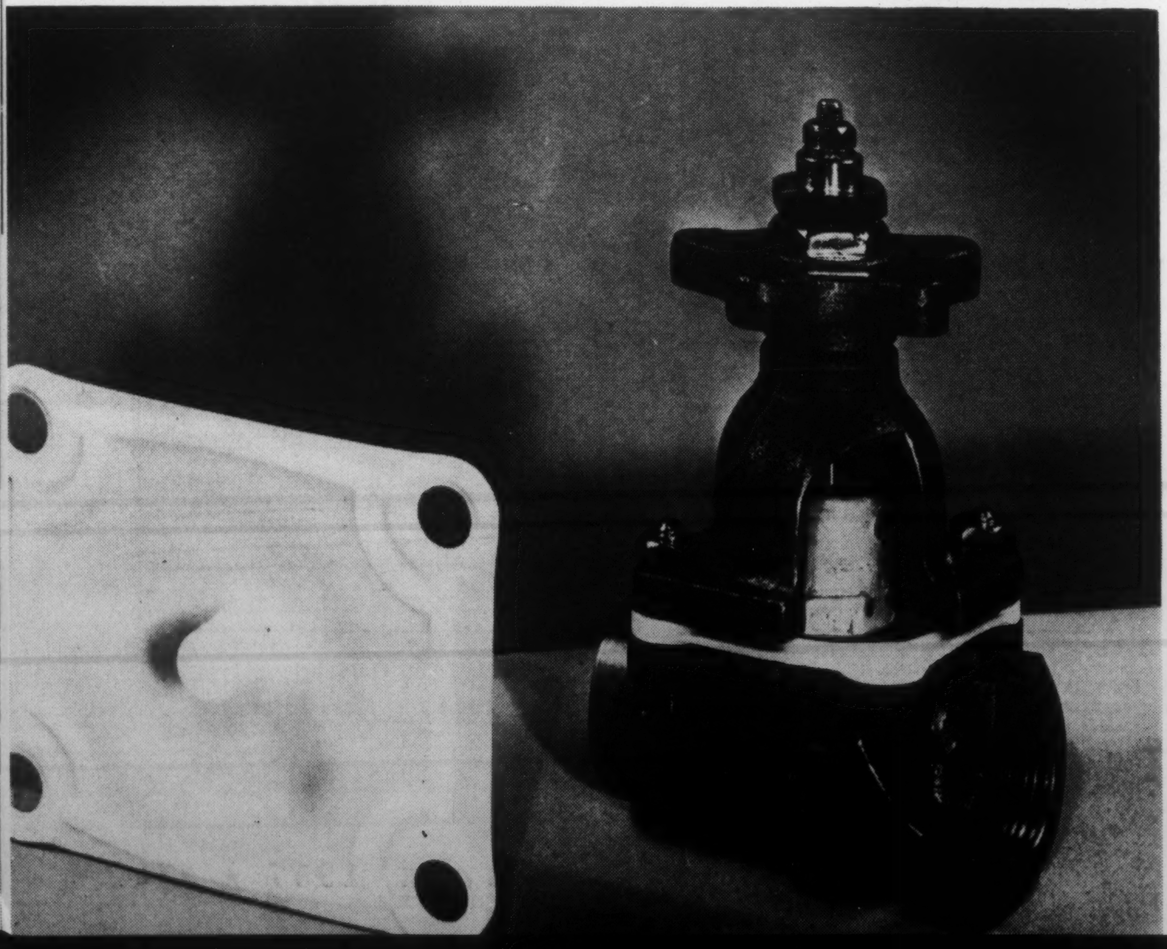


Fig 8—*Effect of crystallinity on fatigue characteristics of TFE.*

Diaphragm *of molded TFE is used in this Hills-McCanna valve used to handle corrosive chemicals at elevated temperatures.*

Raybestos-Manhattan, Inc.



Deformation and set—A comparison of the resistance to deformation of the two types of fluorocarbons can also be made on the basis of modulus of elasticity in compression. CFE has a modulus of about 180,000 psi. Moduli of TFE range from about 70,000 to 90,000 psi depending on crystallinity.

In addition to higher compressive modulus, CFE shows a much smaller permanent set after deformation, indicating good plastic memory. Bearing loads of 8000 psi result in only 4 to 5% permanent set in CFE, as opposed to a permanent set of about 30% in TFE at room temperature. Fig 6 shows compression - deformation and permanent set characteristics of TFE, and indicates the effect of temperature on these properties. Deformation vs time at various temperatures for TFE under a compressive stress of 1000 psi is shown in Fig 7. The greatest degree of cold flow occurs during the first few hours of loading, after which rate of deformation decreases and approaches zero.

Fatigue — There is relatively little fatigue information available on the fluorocarbons. Some fatigue characteristics of TFE are shown in Fig 8. The curves show effect of crystallinity on the number of flexes to failure, and stress rupture strength at two temperatures and under two conditions of crystallinity.

Impact — Impact strengths of TFE and CFE are similar at room temperature. They range typically from 2 to 3 and 3 to 4 ft-lb per in. notch (Izod), respectively, though minimum values for CFE may be considerably lower. At about -450 to -455 F (about 4K—in the liquid

TFE Bearing Properties

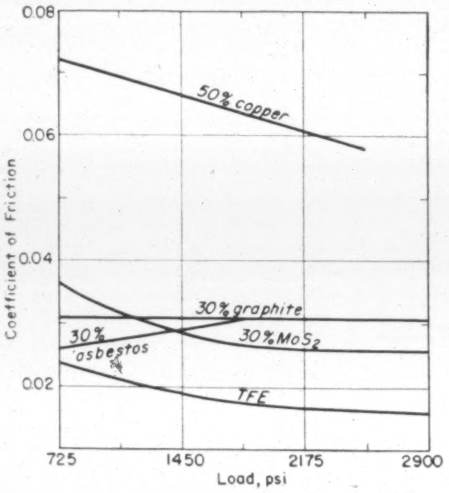
Coefficient of friction

EFFECT OF LUBRICANT
(Reinforced TFE)

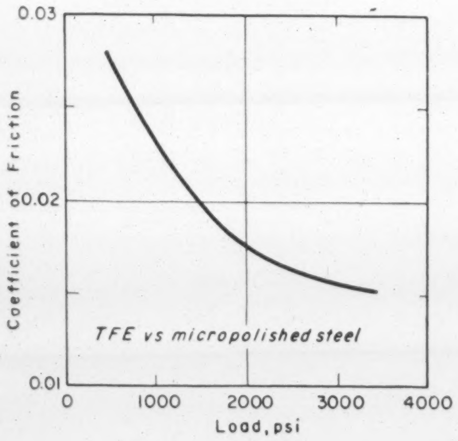
Lubricant ▼	TFE: Asbestos (3:1 by wt)	TFE: Copper (1:1 by wt)
None	0.15	0.16
Water	—	0.09
Oil	0.04	0.04

Source: Milz, W. C., and Sargent, L. B., Jr., "Frictional Characteristics of Plastics", presented to American Society of Lubrication Engineers, Chicago, Apr '55.

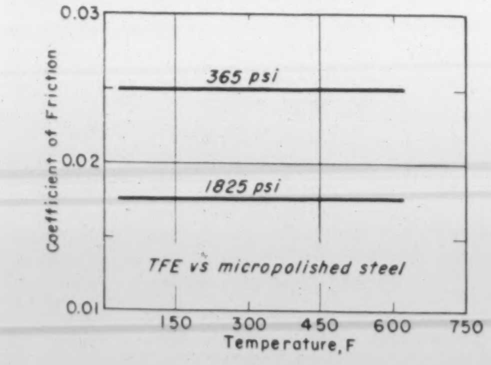
EFFECT OF FILLERS AND LOAD



EFFECT OF LOAD



EFFECT OF TEMPERATURE



EFFECT OF FILLERS

Filler	Amount of Filler, % by wt	Dynamic Coefficient of Friction
Surface Speed: 1 ft/min, Load: 1500 psi		
None	—	0.016
Molybdenum	30	0.026
Disulfide	30	0.031
Graphite	10	0.017
Coke Flour	20	0.023
	30	0.027
Surface Speed: 20 ft/min, Load: 120 psi		
None	—	0.26
Glass Fiber	25	0.230
Graphite	40	0.190
Bronze	40	0.240
Copper	85	0.330

EFFECT OF RUBBING SPEED

Apparatus	Approx Rubbing Speed, ft/min	Coefficient of Friction
Sliding Hemisphere	0.02 to 2	0.04
Sliding Hemisphere	0.02	0.04-0.1
Flat Ring	Hand Turning	0.016
Crossed	8	0.09
Cylinders	367	0.21
Rotating Cylinder	2	0.05-0.08

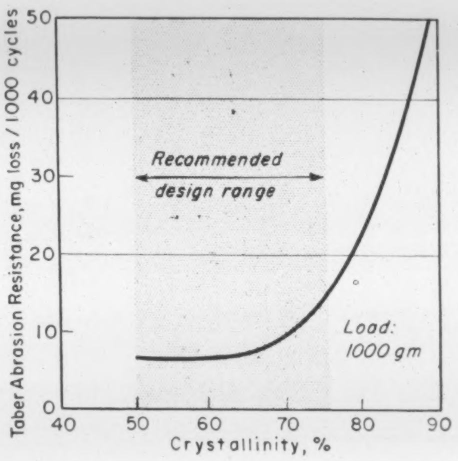
Wear and abrasion resistance

EFFECT OF FILLERS[a]

Filler	Avg Wear Per Million Revolutions, in.
None	Too worn to measure
Glass Fiber (20%) and MoS$_2$ (20%)	0.00017
Glass Fiber (25%)	0.0005
Mica	0.0006
Aluminum (40%)	Too worn to measure
Bronze (40%)	0.00005
Copper (85%)	0.001
Graphite (40%)	0.00077

[a] Dry. Conditions of test: ½-in. dia hollow shaft of hardened drill rod; temperature maintained at 100 F by water cooling; speed 156 rpm; bearing pressure 120 psi under normal room conditions.

EFFECT OF CRYSTALLINITY

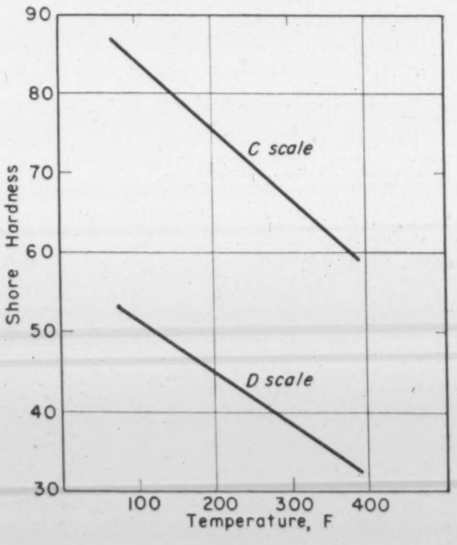


Hardness

EFFECT OF FILLERS (77 F)

Filler	Amount of Filler, % by Vol	Hardness, Shore D
None	—	55-65
Coke Flour	12.5	68
	25.0	67
	50.0	71
Asbestos	12.5	63
	25.0	68
	33.3	70
Glass Fiber	12.5	66
	25.0	67
	33.3	73
	50.0	70
Copper	8.0	59
	15.5	62

EFFECT OF TEMPERATURE



helium temperature range) TFE is still somewhat ductile. At these temperatures it has an elastic region and an elastic limit, beyond which deformation up to several percent is observed. CFE and polyethylene in this same temperature range show brittle failure at 44,000 and 25,000 psi respectively.

Friction—Both types of fluorocarbon plastics have nonstick surfaces. TFE has a lower coefficient of friction (0.04 for TFE against TFE vs approximately twice that value for CFE, depending on conditions), and the static coefficient is the same as the kinetic, eliminating stick-slip characteristics. Also, when TFE is used against a metal, in a bearing application the frictional coefficient after a brief run-in period approaches the 0.04 value due to deposition on the metal of a monomolecular layer of TFE. Thus, after the run-in period the bearing surfaces, in effect, are TFE vs TFE.

A number of filled TFE materials have been developed to provide the desired combination of low coefficient of friction and good resistance to deformation and abrasion. Fillers that have provided satisfactory results include molybdenum disulfide, graphite, coke flour, asbestos, glass fibers and copper. Though any inorganic reinforcing material capable of withstanding the 640 F sintering temperature can be used, graphite, glass fiber and molybdenum disulfide have been most commonly used. The accompanying box on "TFE Bearing Properties" (see p 137) gives data on hardness, coefficient of friction, and wear and abasion resistance of TFE at various temperatures, under various loads and with various fillers. (For further information on fluorocarbon bearing characteristics see "Materials for Small, Oil-Free Bearings," MATERIALS & METHODS, Apr '57, p 135.)

The general effect of reinforcing materials is to increase stiffness, hardness and compressive strength, and reduce elongation and deformation under load. Quantity of reinforcing material to be used is dictated by end use requirements and usually will not exceed 35% by *volume*. Some reinforcing materials produce compositions with outstanding properties. A

Chemical Resistance of CFE[a]

Reagents producing less than 0.02% weight change:

Acetic acid
Acetic acid, 5%
Acetic anhydride
Acetophenone
Ammonium hydroxide, 10%
Amyl acid phosphate
Aniline
Antimony pentachloride
Aqua regia
Aroclor 1242[b]
Aroclor 1248[b]
Aroclor 1254[b]
Benzaldehyde
Benzonitrile
Benzoyl chloride
Benzyl alcohol
Butyl alcohol
Carbitol acetate
Cellosolve
1-Chloro-1-nitropropane
Chlorotrifluoroethylene liquid polymer
Chromic acid cleaning solution
Cresol
Cyclohexanone
Dibutyl phthalate
Dibutyl sebacate
1,2-Dichlorobutane
3-Dichloroethyl ether
2,4-Dichlorotoluene
3,4-Dichlorotoluene
Dicyclopentadiene
Diethylenetriamine
Dioxane
Ethyl alcohol, 50%
Ethyl alcohol, 95%
Formic acid
Halowax 1000
n-Heptane
Hydrochloric acid, 10%
Hydrofluoric acid, 50%
Hydrogen peroxide, 3%
Hydrogen peroxide, 30%
Methanol
Mineral oil
Naphtha solvent
Nitric acid
Nitric acid, fuming, 89 to 95%
Nitric acid, 10%
Nitrobenzene
Nitromethane
Oleic acid
Pentachloroethane
Perfluorotriethylamine
Santicizer B-16[b]
Santicizer E-15[b]
Santicizer M-17[b]
Santicizer 8[b]
Santolube 31[b]
Sodium carbonate, 2%
Sodium chloride, 10%
Sodium hydroxide, 1%
Sodium hydroxide, 10%
Stannic chloride
Sulfuric acid
Sulfuric acid, 3%
Sulfuric acid, 30%
Sulfuric acid, 20% free SO_3
Sym-Tetrachloroethane
1,1,2-Trichloroethane
1,2,3-Trichloropropane
Water, distilled

Reagents producing 0.02 to 0.37% change:[c]

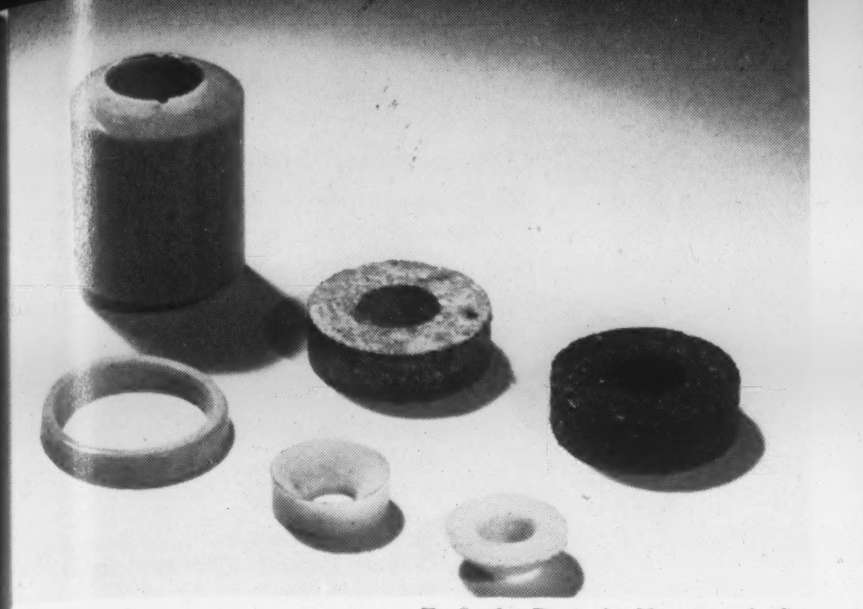
Hydrofluoric acid, anhydrous
Pyridine
Cellosolve acetate
Ethylene chloride
Propylene chloride
Bromobenzene
Piperidine
n-Butyl ether
Bromine
o-Chlorotoluene
p-Chlorotoluene
Amyl acetate
Ammonia, anhydrous
Carbon disulfide
Acetone
1,2-Dichlorohexylfluorocyclobutane
Sulfur dioxide, anhydrous
Methyl formate
Acetyl chloride
Diethyl Carbitol
1,1,1-Trichloroethane
Methallyl chloride
n-Propyl formate
Methyl ethyl ketone
Methylene chloride
Triethylamine
Ethyl formate
Isopropyl ether
Allyl chloride
Benzene
2-Chloropropane
n-Propyl ether
n-Butyl acetate

Reagents producing greater than 0.38% change:[c]

n-Propl propionate
m-Xylene[d]
Carbon tetrachloride
Toluene[d]
Ethyl n-butyrate
n-Propyl acetate
Diethyl Cellosolve
Methyl n-butyrate
Tetrachloroethylene
Methyl acetate
Ethyl propionate
Freon-113[a]
Ethyl acetate
Methylal
Methyl propionate
Diethylamine
Trichloroethylene
Furan
Ethyl ether
Methyl ether
Chlorotrifluoroethylene
Chlorine, anhydrous (147 hr)

[a] Immersion for 7 days at 77 F.
[b] Monsanto Chemical Co.
[c] Reagents listed in order of increasing severity of attack.
[d] Smaller volume swells after exposure to this reagent are reported by some companies.

Source: Adapted from Frey, S., Gibson, J. D., and Lafferty, R. H., Jr., "Effect of Chemicals on Fluorothene," *Industrial and Engineering Chemistry*, Vol. 42, Nov '50.



E. I. du Pont de Nemours & Co.

Valve and pump packings *made of both unfilled and filled TFE are one of the most useful applications for the material.*

Porous Plastic Filter Co.
E. I. du Pont de Nemours & Co.

Cup filters *are made of TFE which is fabricated to retain a specific degree of porosity. Such filters can filter particles larger than 3 microns from liquids, and particles larger than 0.1 micron from gases.*

graphite composition provides thermal conductivity of 19.5 Btu/hr/sq-ft/°F/in. An asbestos composition has a modulus of elasticity in flexure of 1,200,000 psi.

Chemical properties

Probably the best known property of fluorocarbon plastics is their exceptional chemical stability. The resistance of TFE is superior to that of CFE because it is completely saturated with fluorine; the chlorine in CFE provides a somewhat vulnerable spot for permeation by some chemicals, which may cause swelling. The material can usually be returned to its original state by using heat to drive off the absorbed chemical.

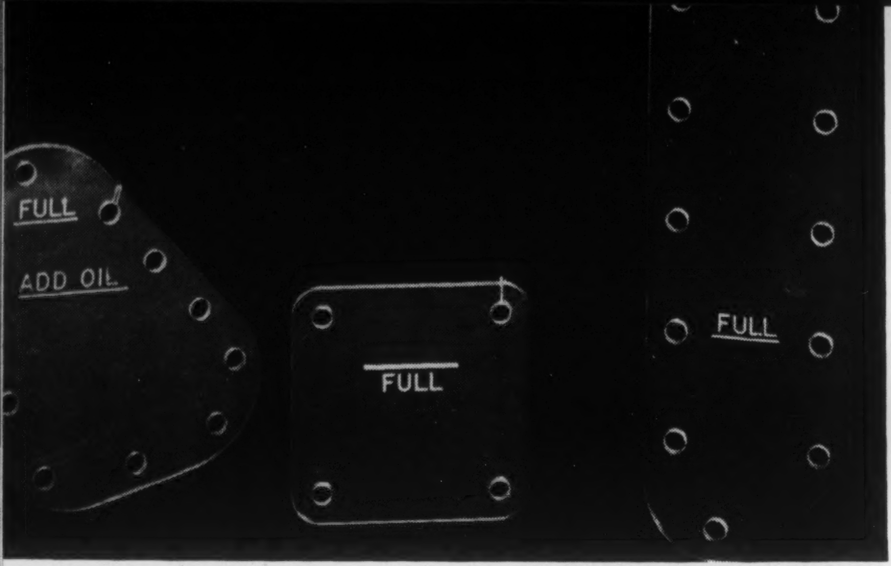
TABLE 4—CHEMICAL RESISTANCE OF CFE AT ELEVATED TEMPERATURES[a]
(Seven days immersion at 345 F)

Chemical	Weight Change, %	Chemical	Weight Change, %
Acetic Acid (50%)	0.07	Formic Acid (87%)	2.9[e]
Acetic Acid, Glacial	0.23[b]	Freon 113	22.4[d]
Acetic Anhydride	0.10[b]	Gallic Acid[f]	0.20
Aluminum Chloride[f]	−0.04	Glycerol	−0.08
Ammonium Chloride[f]	0.12	Heptane	1.8[d]
Ammonium Hydroxide (28%)	0.64	Hexone	4.5[d]
Ammonium Persulfate[f]	0.01	Hydrogen Sulfide[f]	0.07
Ammonium Sulfate[f]	0.06	Isoamyl Alcohol	1.4[c]
Amyl Acetate	0.87[b]	Mercuric Chloride[f]	−5.6
Aniline	0.01[b]	Methyl Ethyl Ketone	4.9[c]
Arsenic Acid (30%)	−0.1	Nitric Acid (white fuming)	0.3
Benzene	107.[c]	Nitric Acid (70%)	0.01[b]
Benzoic Acid[f]	0.12[d]	Nickel Ammonium Sulfate[f]	0.25
Bromobenzene	1.9[b]	Phenol (5%)	0.27
Butyl Acetate	6.5[c]	Potassium Dichromate[f]	−0.01
Butyl Alcohol	0.01[b]	Pyrogallic Acid[f]	0.05
Calcium Chloride[f]	3.9	Salycylic Acid[f]	0.21
Carbon Tetrachloride	600.[c]	Sodium Bisulfite[f]	−0.7
Chloroform	8.5[f]	Sodium Borate[f]	0.18
Chromic Acid[f]	−0.01	Sodium Chloride[f]	−0.04
Cupric Chloride[f]	−0.02	Sodium Hydroxide (30%)	−1.2
Cupric Sulfate[f]	0.00	Sodium Phosphate[f]	0.04
Diisobutyl Ketone	1.2[d]	Silicone Oil DC 200	0.1[b]
Dioxane	5.7[d]	Stannic Chloride[f]	0.06
Ethylacetate	6.5[b]	Sulfuric Acid (96%)	0.00[b]
Ethylalcohol	0.38[e]	Thionyl Chloride	8.5[d]
Ethylene Chloride	1.2[b]	Titanium Tetrachloride	2.6[d]
Ethylene Glycol	0.01	Toluene	6.9[d]
Ferric Chloride[f]	−0.01	Trichloroacetic Acid	0.03[b]
Ferrous Chloride[f]	−0.02	Trichloroethylene	9.8[d]
Ferrous Sulfate[f]	0.02	Xylene	6.5[d]
Formaldehyde	0.70[e]	Zinc Sulfate[f]	0.40

[a] Inorganic reagents: No changt in appearance of CFE, except for some darkening in ammonium salt solutions. Organic reagents: Some softening where swelling values are high.
[b] 158 F. [c] 275 F. [d] 194 F. [e] 275 F. for 5 hr. [f] Saturated aqueous solution at 77 F.

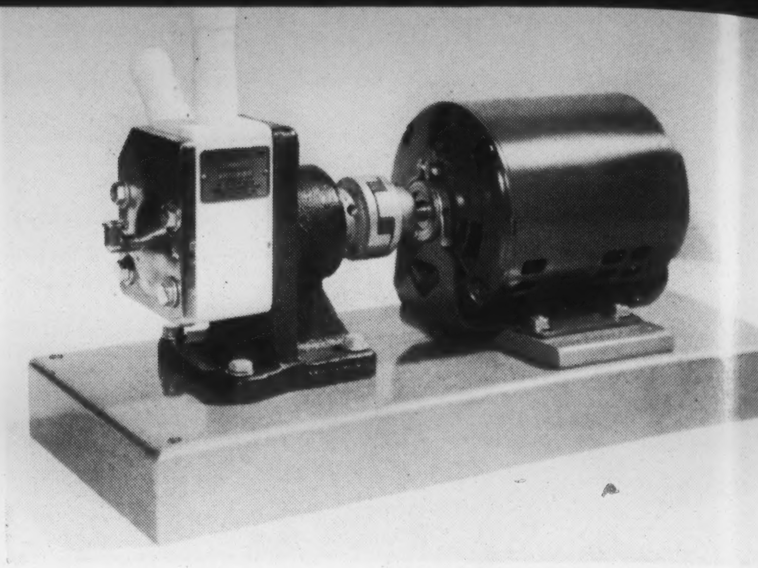
The TFE polymer is inert to most chemicals and solvents with the exception of alkali metals under certain conditions. At elevated temperatures and pressures halogens and certain halogenated chemicals and solvents may affect TFE. Molded parts reinforced with other materials, such as glass, have slightly poorer chemical resistance. Chemical resistance of such compositions is dependent primarily on the filler used. In some cases the reduction in chemical resistance is insignificant.

CFE is impervious to the action of corrosive chemicals and highly resistant to most organic solvents. No effect has been observed after prolonged exposure to weak and concentrated mineral acids, vigorous oxidizing agents, and strong and weak caustics. Swelling may occur with some highly halogenated and aromatic materials which can permeate the polymer. Use under such conditions would be predicated on limits of attack allowable in specific designs. An accompanying box lists reagents and their quantitative affects on CFE. They are grouped in three



Minnesota Mining and Mfg. Co.

Sight glasses *used to check quantity of helicopter transmission oil make use of CFE's transparency as well as its chemical and thermal stability and resistance to shock and vibration.*



Vanton Pump & Equipment Corp.

All-fluorocarbon pump, *consisting of TFE body block and CFE elastomer pump liner, permits handling of extremely corrosive chemicals.*

Electrical Properties of Fluorocarbons

TYPICAL ELECTRICAL PROPERTIES

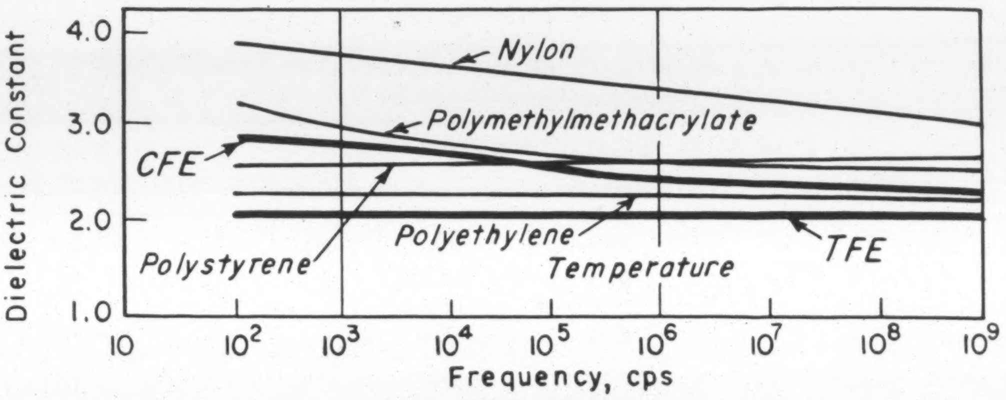
Property ▼ Material ➔	TFE	CFE
Dielectric Strength		
Short Time (1/8 in.), v/mil	400[a]	450
Step-by-Step (1/8 in.), v/mil	350[a]	390
Volume Resistivity (dry 73 F), ohm-cm	10^{19}[a]	10^{18}
Dielectric Constant		
60 cps	2.0	2.65
1000 cps	2.0	2.54
10^6 cps	2.0	2.34
3000 x 10^6 cps	2.0	2.29
Dissipation Factor		
60 cps	0.0002	0.015
1000 cps	0.0002	0.018
10^6 cps	0.0002	0.005
3000 x 10^6 cps	0.0002	0.0038
Loss Factor		
60 cps	0.0004	0.039
1000 cps	0.0004	0.046
10^6 cps	0.0004	0.012
3000 x 10^6 cps	0.0004	0.0087

[a] 40-mil sheet.

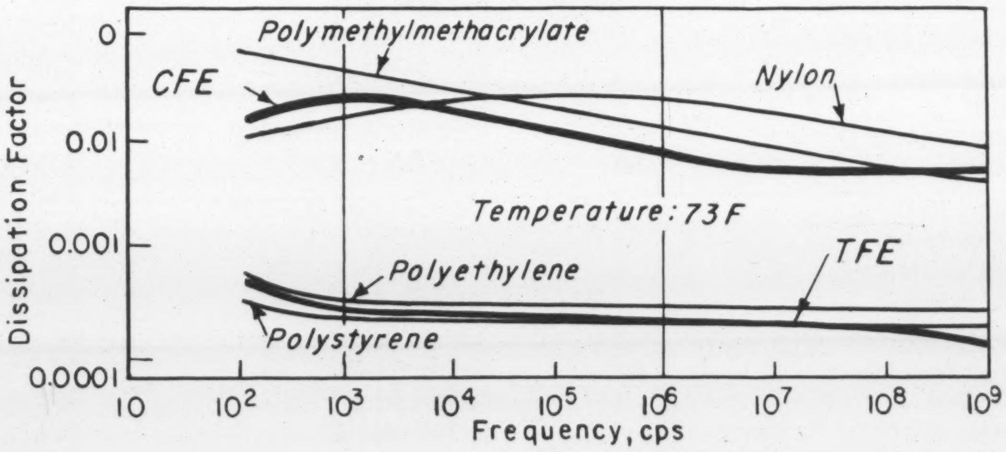
Source: Manufacturing Chemists' Assn., *Technical Data on Plastics.*

Effect of frequency on . . .

DIELECTRIC CONSTANT

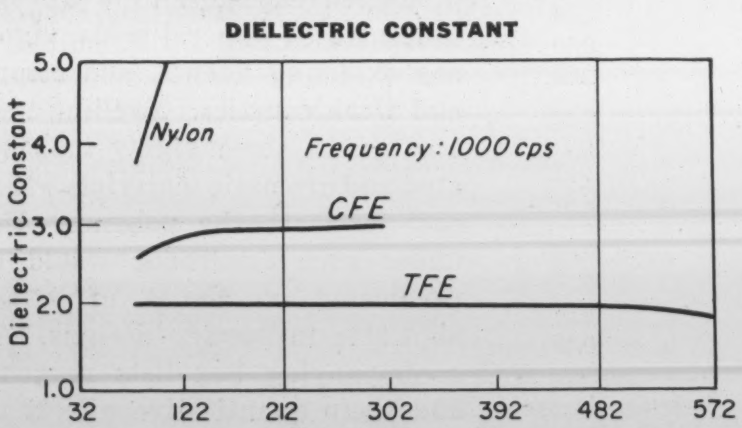


DISSIPATION FACTOR

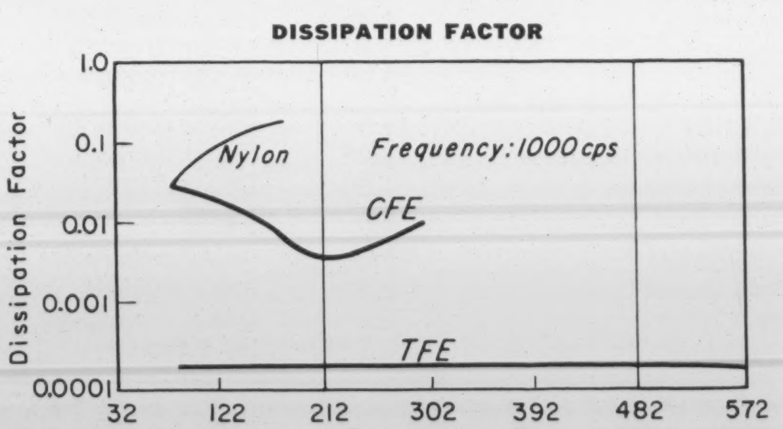


Effect of temperatures on . . .

DIELECTRIC CONSTANT



DISSIPATION FACTOR



sections: 1) reagents producing less than 0.02% weight change, 2) reagents producing 0.02 to 0.37% weight change, and 3) reagents producing more than 0.38% weight change after immersion for 7 days at 77 F. Elevated temperatures increase the severity of attack on CFE, as shown in Table 4.

Electrical properties

Both types of fluorocarbon plastics are excellent dielectrics when fabricated properly to preclude voids and pin holes. The combination of their dielectric qualities with their thermal and chemical stability and zero moisture absorption has resulted in their wide use in electrical equipment. An accompanying box ("Electrical Properties of Fluorocarbons") compares primary dielectric properties of the materials, and indicates the effects of frequency and temperature on these properties.

In general, TFE has the better dielectric characteristics. It has an extremely low dissipation factor of 0.0002 over a frequency range of 60 cycles to 3000 mc. Dissipation factor of CFE ranges from 0.015 to 0.0038 over the same frequency range. Dielectric constant of TFE is 2.0, essentially regardless of frequency, and that of CFE ranges from 2.65 to 2.29 over a range of 60 cycles to 3000 mc. Volume resistivity of TFE is 10^{19} ohm-cm, as compared with approximately 10^{18} for CFE.

Both fluorocarbons have similarly good short time dielectric strength; it ranges from 500 to 2000 v per mil, depending on thickness. Recommended working stresses for TFE at 390 F range from 10 to 100 v per mil. Arc resistance of both materials is good; that of TFE is greater than 200 sec, and that of CFE is greater than 360 sec. Neither material forms a carbonized conducting path during arcing.

The addition of reinforcing materials to TFE increases dielectric constant and dissipation factor, and decreases dielectric strength and volume and surface resistivity. Arc resistance may remain unchanged or be reduced, depending on the nature of the reinforcement.

Designing with Fluorocarbons

Because of the nature of fluorocarbon plastics, fabricating and forming techniques play a more important part in selecting the material than they do in designing with other types of plastics. The properties of fluorocarbons are useless to the engineer unless he can obtain them in the desired area of his product. Fluorocarbons can be specified in the form of moldings, extrusions, laminates or coatings. However, the fabricating techniques and the results of these techniques on the end product must be considered.

Moldings, extrusions, cast film

TFE — Though technically a thermoplastic, TFE has such a high melt viscosity that it cannot be molded or extruded by conventional means. The process used for molding the material is similar to that used for powder metallurgy. Molding powder is compacted in a compression molding press at room temperature, and the "green" part is then sintered at temperatures around 650 F.

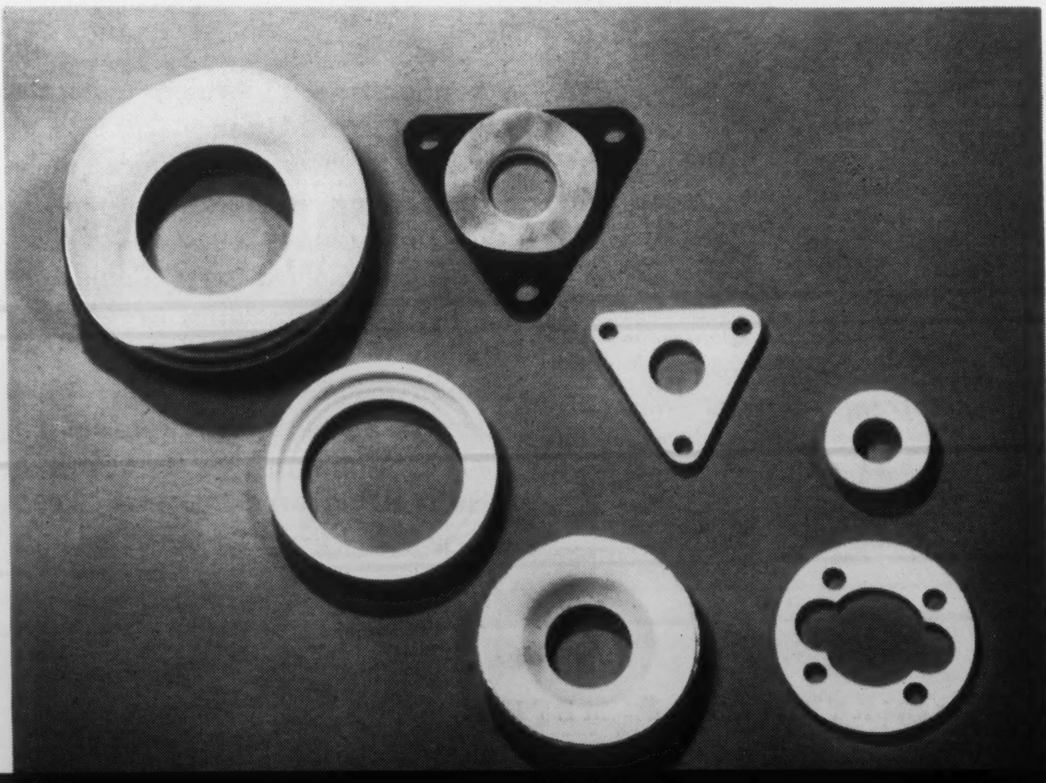
After sintering, the part can be quenched to obtain minimum crystallinity, or slow cooled to provide higher and varying levels of crystallinity. As indicated previously, the level of crystallinity will depend on the geometry of the part and the resulting heat transfer characteristics. In general, limitations on the shape of moldings are similar to those for conventional compression moldings, though flow is extremely limited because it is a powder that is being compacted.

Both ram and screw techniques can be used to extrude TFE. Ram extrusion is generally preferred because it usually allows higher production rates at lower costs. In ram extrusion, general purpose powder is fed automatically to the extrusion cylinder and compacted ahead of a reciprocating ram. Succeeding strokes move the compacted powder through the heated die, where it is sintered.

An extrusion powder is available for extrusion of thinner sections than are possible with ram extrusion of molding powder. This powder is particularly well suited to extrusion of thin-wall tubing,

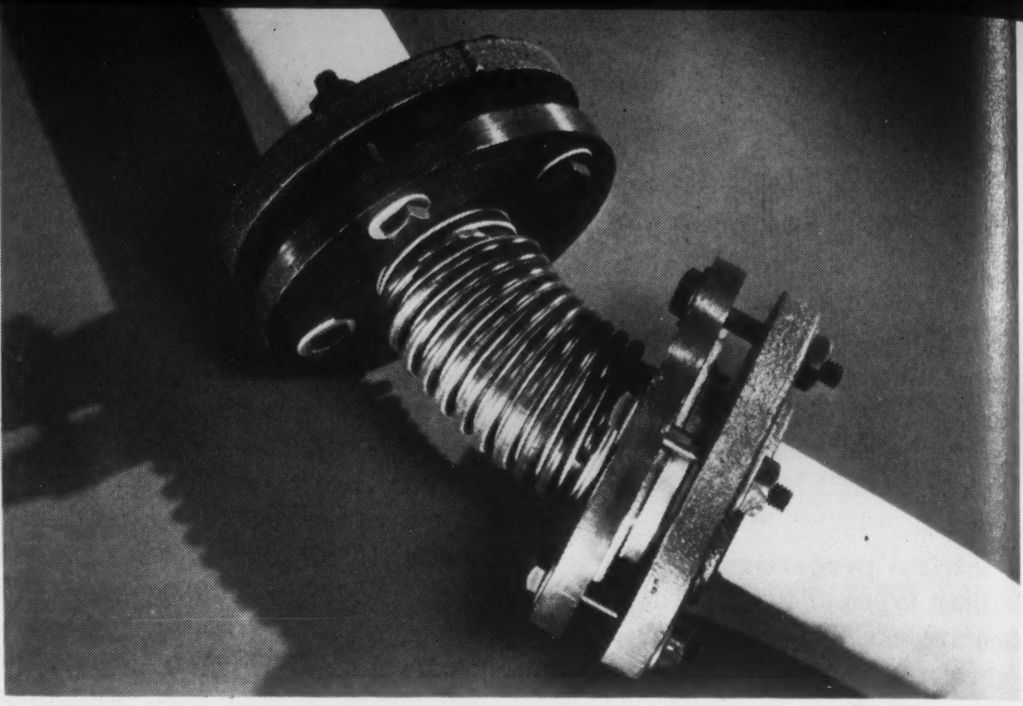
Gaskets *made of TFE outlasts those made of other materials because of their superior chemical and thermal stability.*

E. I. du Pont de Nemours & Co.



U.S. Gasket Co.
E. I. du Pont de Nemours & Co.

Flexible bellows *of TFE are used as vibration dampeners, expansion joints and flexible connectors in heavy duty equipment where service conditions are severe.*



Resistoflex Corp.

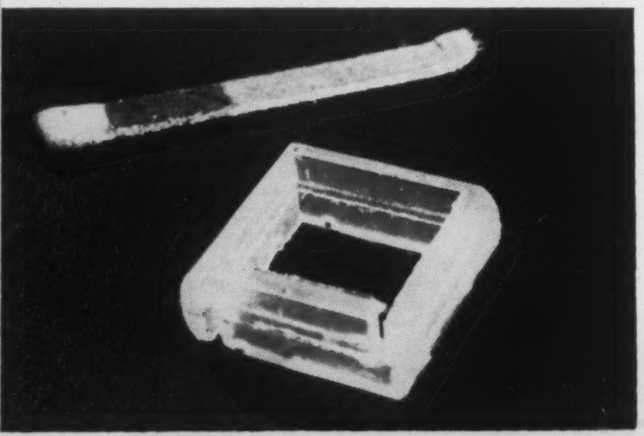
Bellows *molded of TFE use metal reinforcing wire to gain maximum strength and fatigue life.*

wire insulation, or shapes with relatively thin walls (less than 0.080 in.). The powder is compounded with organic liquids of the proper viscosity to produce a "lubricated" powder, which can then be extruded in a lead press. Vaporization of the organic liquid and sintering of the TFE take place in successive heating zones as the material is extruded. Properties of parts made of such compounds are substantially the same as those for parts made from general purpose powder (see Table 2).

Cast films of TFE can be produced by using a dispersion of TFE and a nonionic wetting agent. The film is built up of successive coatings of the dispersion, which can be applied by dipping, flowing or spraying. Each layer must be baked and sintered before a subsequent coat is applied. When the desired thickness has been achieved, the finished film is stripped from the metal surface.

CFE—CFE can be formed by more conventional injection molding and extrusion techniques, similar to those used for other thermoplastics, as well as by compression and transfer molding. The modifications of standard molding conditions necessary to mold CFE include higher temperatures (420 to 580 F), closer control over these temperatures, and higher pressures (20,000 to 60,000 psi). Control of molding temperatures is critical because in some cases these temperatures must be maintained at just under 600 F—the temperature at which molecular weight degradation starts.

Fig 9 shows the typical effect of molding variables on the stiffness modulus of one type of CFE injection molded parts. Conditions for transfer molding are similar to those for injection molding. In compression molding temperatures can be substantially lower (480 F), since minimum flow is required. Extrusion equipment must be constructed of corrosion resistant metals to prevent pitting and subsequent poor quality parts.



Minnesota Mining and Mfg. Co.

Crystal frames *molded from CFE extend effective life and improve operating characteristics of crystal assemblies in portable, fixed-frequency military radio equipment.*

Machined parts

Where dimensional accuracy greater than that obtainable by normal forming techniques is required, fluorocarbon parts can be machined. Machinability is quite good, but experience and a good knowledge of the materials are required on the part of the machinist.

When specifying dimensions to the machinist, the design engineer should not only realistically determine the tolerances that are absolutely necessary, but also evaluate the stresses to be imposed on the close-tolerance area of the part. Though the machine shop can (at appropriate costs) provide extremely close tolerances initially, the cold flow of the material may be sufficient to erase this accuracy under service stresses. Thus, only tolerances that are mandatory should be specified, and when in doubt the processor should be consulted.

Though it is difficult to generalize, standard commercial tolerances (±0.005 in. per in.) can be obtained quite readily. Closer tolerances (±0.0003 in. per in.) can be obtained at higher cost. According to estimates by one fabricator tolerances closer than standard commercial can increase machining costs by 20 to 50%.

Resistoflex Corp.

Chemical beakers *made of TFE require close manufacturing control to ensure lack of porosity which could lead to contamination of chemicals.*

Minnesota Mining and Mfg. Co.

Pipe fittings *of CFE permit entire piping systems to be made of the fluorocarbon plastics.*

Fluorine-Containing Elastomers

The chemical and thermal stability provided by the addition of fluorine is not obtainable solely in plastics. A comparatively new family of elastomers having in common the presence of fluorine has recently been developed. These elastomers have been developed primarily to meet critical needs for high and low temperature stability and resistance to chemicals and fluids.

In an article next month the latest design information on these elastomers will be presented. Elastomers to be covered include:

- Kel-F Elastomer
- Fluoro-Silicone LS-53
- Fluoro-Rubber 1F4
- Viton A
- Fluoro-Polyester

Both types of fluorocarbons have relatively high coefficients of thermal expansion (7 to 10 x 10^{-5} over a range of 68 to 300 F), and the effect of this expansivity on dimensions and tolerances of machined parts must be considered. Any heat treatment of parts should be carried out after rough machining and before finish machining.

Closer initial tolerances can be produced with CFE than with unfilled TFE, and less support is needed for CFE during machining because of its higher rigidity. Also, precisely machined CFE parts will generally retain their accuracy longer in service than comparable TFE parts subjected to the same stresses.

Bonded joints

Though bonding the fluorocarbons is difficult due to the antistick nature of their surfaces, both TFE and CFE can be bonded to themselves with heat and pressure and bonded to themselves or to other materials by adhesive bonding techniques. Because of the heat resistance of the materials, temperatures required for heat bonding are relatively high. Because of the chemical stability and antistick characteristics of the surfaces, adhesives provide primarily mechanical bonds.

TFE can be welded to itself with contact heaters at temperatures of about 700 F and pressures of about 35 psi. Sections 1/16 in. thick provide optimum results since they have the strength necessary for fabrication, yet are thin enough to be brought to temperature in a relatively short time. Thicker sections can be bonded, but more time is required for heat transfer. Thinner sections can also be bonded, but they are less able to absorb thermal stresses and require more care to prevent permanent deformation of the joint. All sheet stock after joining

TABLE 5—STRENGTH OF HEAT BONDED TFE JOINTS
(After exposure to indicated solutions for 48 hr at reflux conditions)

Property➤	Tensile Strength, psi[a]		Peel Strength, lb/0.5 in. width[b]	
Solution⮟	Room temp	212 F	Room temp	212 F
Acetone	2540	1780	19.5	29.6
Benzene	2270	1560	16.6	16.6
Carbon Tetrachloride	2180	1330	18.3	35.0
Cetane	1580	1515	16.1	28.0
10% Sulfuric Acid	1985	1540	23.3	31.0
10% Sodium Hydroxide	2160	——	19.6	29.1
Unexposed Control	2240	1260	21.0	24.1

[a] Tested on Instron, Cell D; crosshead speed 2 ipm; 2-in. jaw distance. Failure occurred in the material before any of the bonds separated.

[b] Test conditions same as for tensile strength, except that 1 in. jaw distance was used.

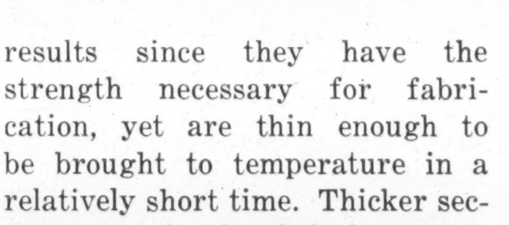
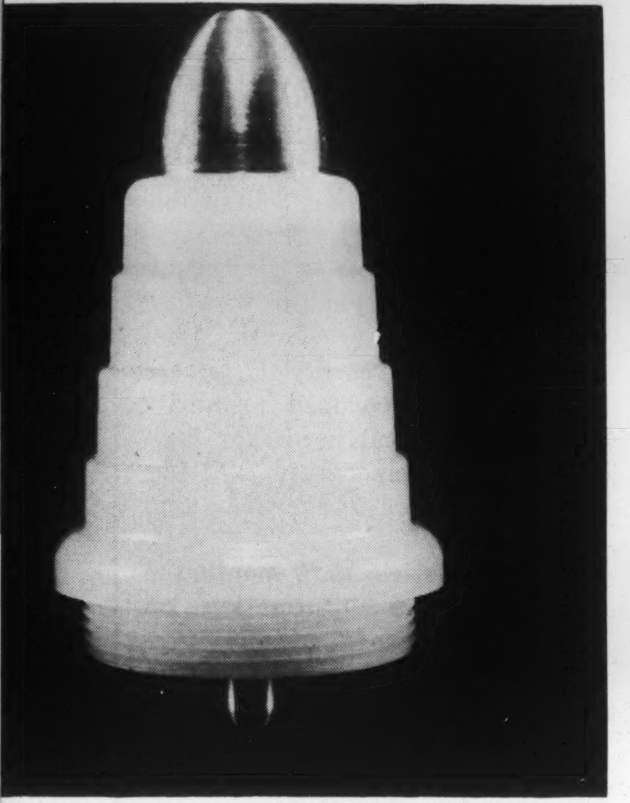


Fig 9—*Effect of injection molding conditions on rigidity of CFE.*

(Bakelite Co.)



Minnesota Mining and Mfg. Co.

Antenna insulator, *compression molded of CFE by Fluoro Plastics Inc., is designed for use in the minimum frequency range. It can safely handle voltages up to 10,000 at current flows of 8 amp.*

should be stress relieved for 2 hr at 90 deg F above the maximum anticipated service temperature.

Scarf joints are most satisfactory since they avoid the bulk of lap joints and provide tight closures. Sharp feather edges on the scarf should be avoided, as they may warp when heated. Strength of heat bonded joints can be improved by use of a flux composed of 65 parts fluorocarbon oil and 35 parts powdered TFE. The flux should be mixed and applied at about 150 F. Equally good results can be obtained by using, in place of the flux, unsintered TFE tape, which can be cut to conform to the contour of the bond, then inserted in the contact area.

The heat bonding operation is a critical one in that temperatures and pressures must be uniform and carefully controled. Cold spots result in poor bonds which must be resealed. The degree of toxicity of TFE when heated has been determined by the Kettering Laboratory. Teflon does not give off toxic fumes at temperatures below 570 F, but does at temperatures above 700 F (WADC Technical Report 54-301).

Areas that have been heat bonded are stronger than the adjacent sheet material, even after exposure to corrosive chemicals. Table 5 shows tensile and peel strength values for properly heat bonded TFE joints after exposure to a variety of chemicals.

A relatively new process now permits TFE to be adhesive bonded either to itself or to other materials (see M&M, Apr '56, p 118). The process involves immersion of TFE in metallic sodium and liquid ammonia, which etches the surface of the film, providing a gripping area for the adhesive. Table 6 shows bond strengths obtained between TFE tape and various materials with several adhesives. Retention of adhesive bond strength between TFE surfaces after chemical exposure is shown in Table 7.

When the assembly is to be used at elevated temperatures or in exposure to chemicals, the temperature resistance and chemical stability of the adhesive used is the limiting factor. For installations exposed to ultraviolet light, TFE film should contain a 2%-by-weight dispersion of carbon black to prevent deterioration of the cementable surface.

CFE can be bonded with heat and pressure in a manner similar to that used for TFE, though the operation is less critical because of the lower temperatures (420 to 440 F at 25 to 75 psi pressure). The same care must be taken to obtain uniform temperature over the entire surface of the areas to be joined.

Untreated CFE surfaces are similar to those of TFE in that adhesives will not adhere to them. However, the metallic sodium-liquid ammonia treatment mentioned above etches the surface of CFE, also providing a gripping surface for adhesives.

Laminates

Both TFE and CFE can be specified in the form of laminates with glass cloth or asbestos. Such laminates provide extremely effective printed circuit materials where service conditions such as temperatures and chemical exposure are critical. Laminates are formed from cloth, impregnated with dispersions similar to those used for fluorocarbon coatings. The bond between the fluorocarbon and the cloth is mechanical, but use of the proper fabric re-

TABLE 6—BOND STRENGTH OF ADHESIVE BONDED TFE[a]
(lb per in. width)

Adhesive➔ TFE Bonded to ➘	R-313[b]	M611[c]	NP285[d]
TFE Tape	40.5	30.2	31.7
Rubber	8.0	12.4	3.8
Neoprene	10.6	10.2	10.8
Wood	37.8	41.3	35.5
Steel	62.8	58.7	49.8
Aluminum	45.0	51.2	45.5

[a] Surface treated with sodium-ammonia treatment (see text).
[b] Epoxy type, Carl H. Biggs Co., Inc.
[c] Epoxy type, Rubber and Asbestos Corp.
[d] Epoxy type, Miracle Adhesives Corp.

TABLE 7—BOND STRENGTH OF ADHESIVE BONDED TFE AFTER CHEMICAL EXPOSURE[a]
(lb per in. width)

Adhesive➔ Exposure in ➘	Phenoline 300[e]	R-313[b]	NP285[d]	M611[c]
Control Relative to R-313	0.73	1.00	0.77	1.00
Ethyl Alcohol, 50%	0.29	0.81	0.84	1.00
Carbon Tetrachloride	0.88	0.80	0.75	0.96
Toluene	0.41	0.66	0.75	0.73
Acetone	0.10	0.57	0.52	0.82
Acetic Acid, 5%	0.32	0.64	0.74	0.86
Nitric Acid, 10%	0.55	0.50	1.20	0.79
Hydrochloric Acid, 10%	0.35	0.89	0.73	0.89
Sulfuric Acid, 30%	0.38	0.91	—	0.86
Sodium Hydroxide, 10%	0.18	0.66	0.74	0.82

[a] Relative bond strengths are recorded as a fraction of the base control using R-313 and M611 as 1.00. Exposing temperature: 73 F.
[e] Phenolic type, Carboline Co.

sults in high strength and dimensional stability.

The primary purpose of such laminates is the coupling of the high thermal and chemical stability and dielectric properties of fluorocarbons with the strength and dimensional stability of the reinforcing material. Special laminates intended to serve as anticorrosive lining materials are discussed in the following section.

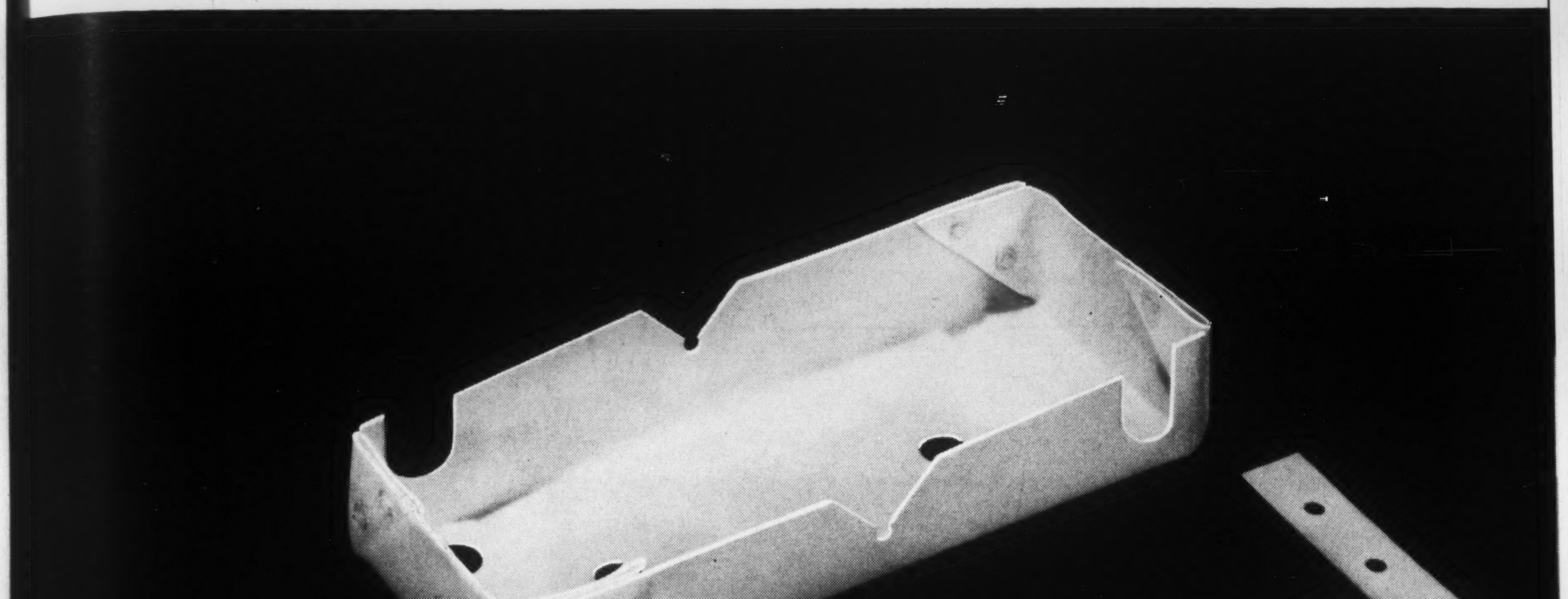
Coatings

Fluorocarbon coatings are of two general types: temporary (air dried) and permanent (fused). (For more complete information see M&M, Nov '55, p 90.)

Temporary air dried coatings are available in CFE only and are obtained by applying low molecular weight CFE waxes or greases. Such coatings can be dislodged relatively easily and are not recommended for use in contact with solvents, high temperatures, or high velocity gases or liquids.

Permanent (fused) fluorocarbon coatings are available in either TFE or CFE and are applied from dispersions or suspensions of finely divided resins in aqueous and spirit vehicles, respectively. They can be applied by brush, dip or spray, but must be fused at high temperatures (475-515 F for CFE, and 650-750 F for TFE). These high fusing temperatures somewhat limit the materials to which the coatings can be applied.

Coatings can be applied to most ferrous and nonferrous alloys,



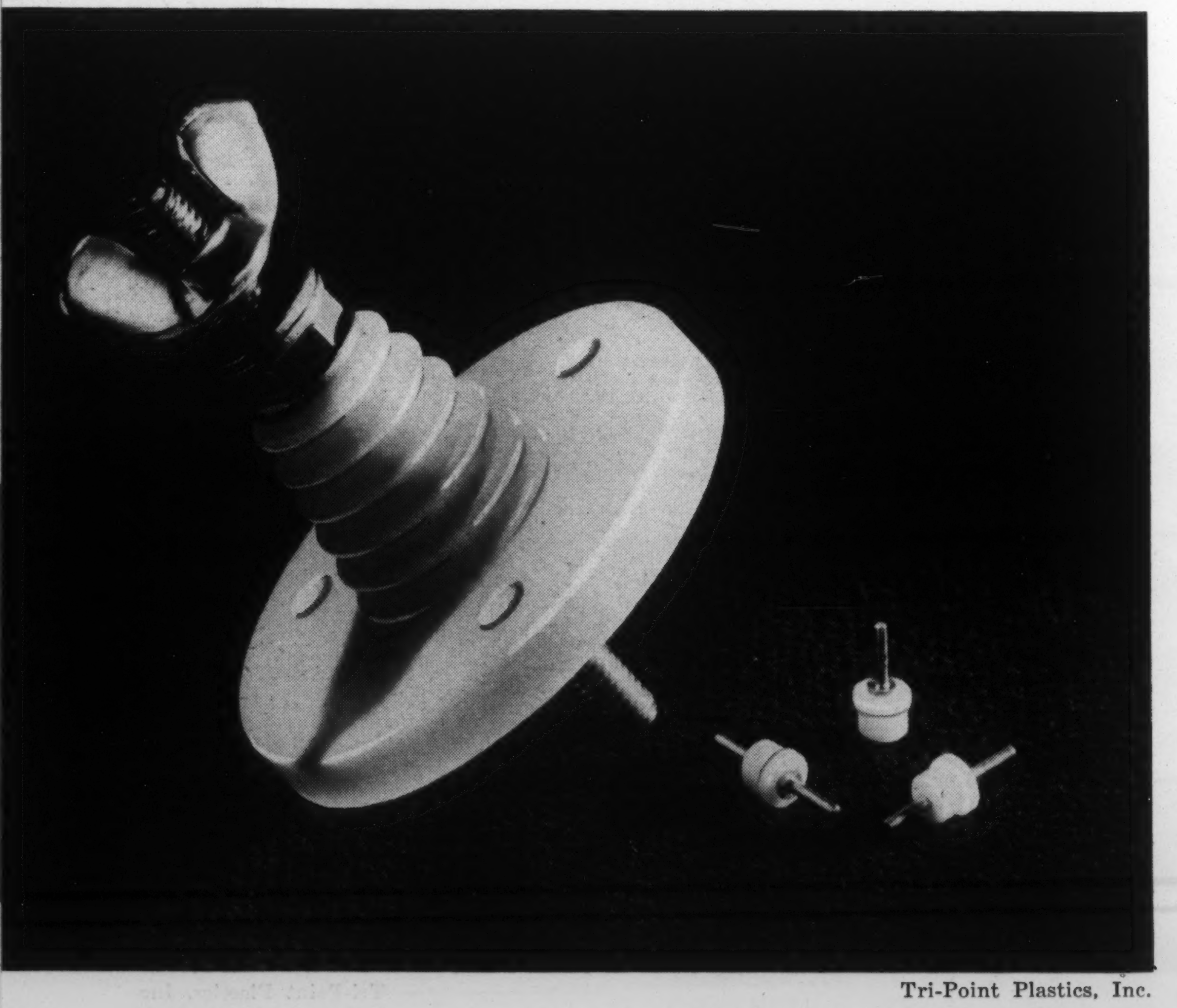
Tri-Point Plastics, Inc.

Electronic panels *and housing shown here are made from sheet TFE, which can be die punched and shaped readily. Flat punched parts are terminal connecting surfaces for electronic applications in ultra-high frequency equipment. Box-like part is an electronic chassis enclosure used to isolate high frequency signals in airborne equipment.*

TABLE 8—PROPERTIES OF FUSED FLUOROCARBON COATINGS

Property ↓ Type →	TFE	CFE[a]	CFE[b]
Specific Gravity	2.1-2.3	2.1	2.12
Durometer Hardness (Shore)	D-55	D-77	—
Adhesion, lb/in.	10.3 (over primer)	5.10 (cannot be peeled off primers)	5 without primer. (cannot be peeled off primers)
Tensile Strength (77 F), psi	1500-2000	4500-5000	5890
Elongation, %	100	150-200	25-87
Izod Impact Strength (77 F), ft-lb/in. notch	4.0	3.5	1.52-3.50
Coefficient of Friction (2-lb load, ½-in. slider)	0.11 (Steel-TFE), 0.04 (TFE-TFE)	0.70 (Steel-CFE), 0.55 (CFE-CFE)	—
Abrasion Resistance	2.60 gm abrasive/mil (Bell Abrasive Tester)	0.0131 gm/1000 cycles (Taber)	0.0117 gm/1000 cycles (Taber)
Thermal Conductivity, Btu/sq ft/hr/°F/in.	1.7	2.16	0.41
Thermal Coefficient of Expansion, per °F	5.5×10^{-5}	$2.5\text{-}3.9 \times 10^{-5}$	2.8×10^{-5}
Max Service Temperature, F			
Short Time	572	420	350
Continuous	480-550	390	300
Burning Rate	Nil	Nil	Nil
Moisture Absorption, %	0.00	0.00	0.00
Water Vapor Transmission, gm/100 sq in./24 hr	—	0.00	0.00
Dielectric Strength (short time), v/mil	400-500	530	600
Power Factor (60 cycles—1 mc)	0.0008-0.007	0.01-0.012	0.01-0.012
Volume Resistivity, ohm-cm	10^{16}	10^{18}	10^{18}
Color Possibilities	Extensive	Unlimited	Unlimited

[a] Minnesota Mining's Kel-F.
[b] Acme Resin's Polyfluoron



Tri-Point Plastics, Inc.

Electrical components *such as this liferaft radio antenna (left) and the subminiature terminals (right) are typical applications for CFE. Inserts are molded-in to provide a mechanical bond.*

glass, glass cloth and ceramics, as well as plated metals. Metals such as copper-base alloys are difficult to coat effectively, since their surface activity may cause peeling of coatings.

In general, fluorocarbon coatings have essentially the same nature as parts molded of the resins (see Table 8). In coatings 4 mils or more thick CFE provides somewhat better protection to base metal than TFE because TFE coatings have a higher degree of porosity. Protection offered by TFE coatings can be markedly improved by undercoating with several coats of primer.

Due to porosity, thin TFE coatings usually provide relatively poor protection when exposed at around 200 F to mineral acids such as nitric and hydrochloric in the liquid and especially in the gaseous phase. They provide good to fair protection against 20% hydrochloric and nitric acids at room temperature, and against 73% caustic, 95% sulfuric acid and toluol at 200 F. Chemical stability of CFE coatings is the same as that of molded parts (see box on p 138).

TFE coatings usually provide relatively poor protection when exposed at around 200 F to mineral acids such as nitric and hydrochloric in the liquid and especially in the gaseous phase. They provide good to fair protection against 20% hydrochloric and nitric acids at room temperature, and against 73% caustic, 95% sulfuric acid and toluol at 200 F. Chemical stability of CFE coatings is the same as that of molded parts (see box on p xxx).

The only limitation on size of parts to be coated is the limitation of the baking or fusion facilities. Techniques have now been developed that permit coating of entire tank cars by a continuous process. In designing parts to be coated, the nature of the coating must be understood. Adhesion of the coatings is mechanical, and the coating, as it shrinks, forms a gripping envelope around the substrate. Thus, sharp edges or projections should be rounded or

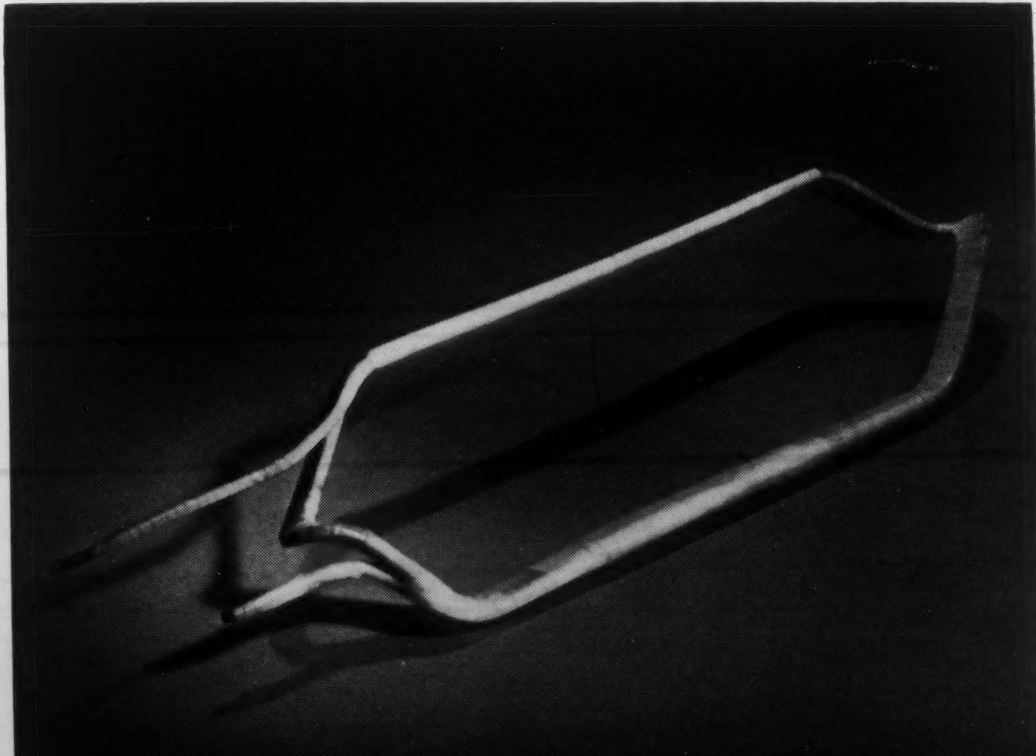
Raybestos-Manhattan, Inc.

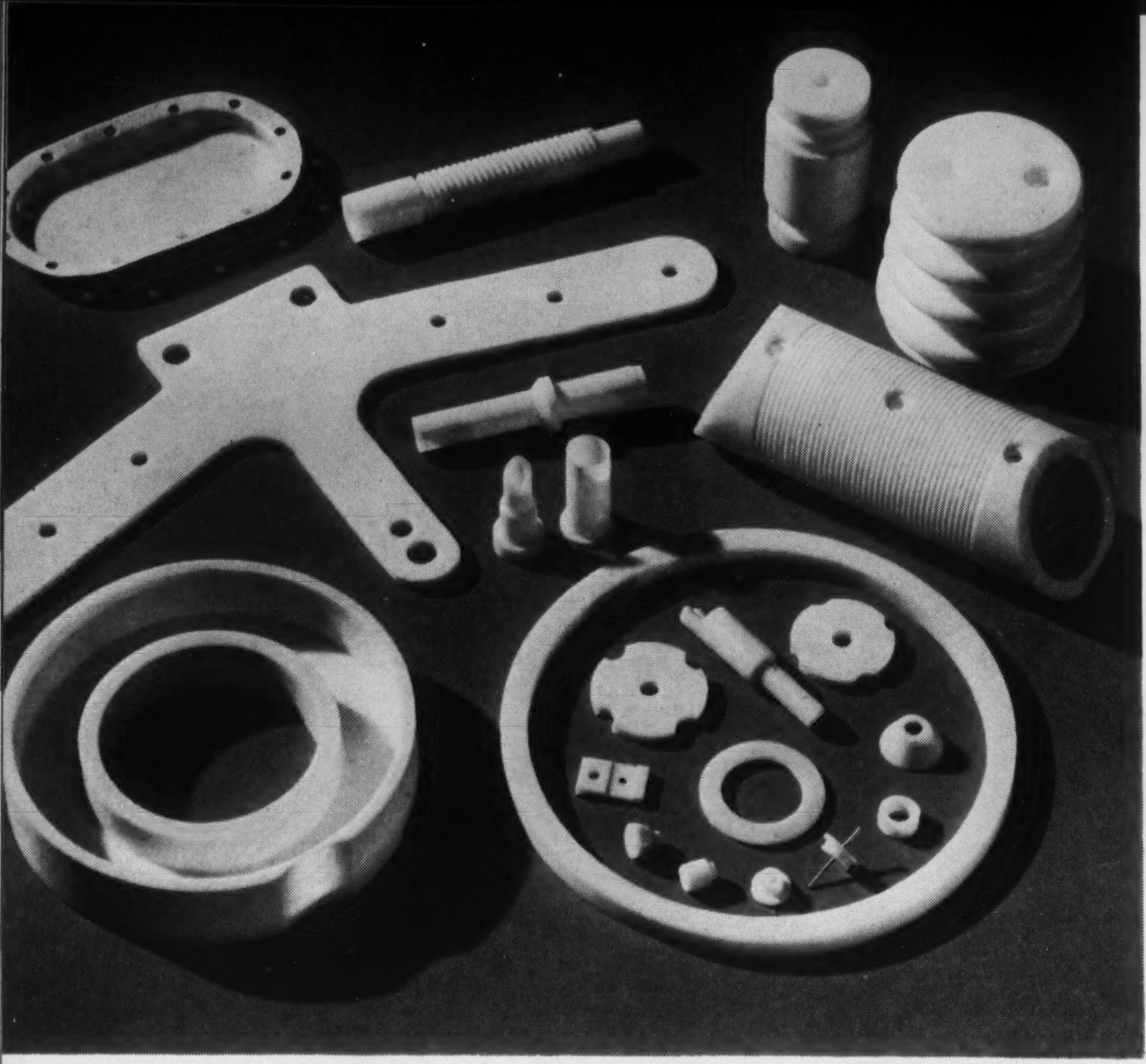
Wire insulation *is made by slitting tape from sheets of TFE. Installation is that of Tensolite Insulated Wire Co.*

filleted to prevent cracking. Cracks, crevices and pores should be sealed with weld metal and flush-ground. When coating weldments, weld quality should be high, since porosity and weld splatter provide vulnerable points for possible puncture of the coating. Also, care must be taken to apply the coating evenly to prevent "mud-cracking." Local build up of coating material can result from applying coatings to an uneven substrate. Though low grade castings are difficult to coat effectively, dense, high quality cast-

Insulating tape *made of TFE can be stretched, allowing it to conform to sharp bends and odd shapes. Its high dielectric properties make it useful as quality insulation in motors, generators and conductors.*

E. I. du Pont de Nemours & Co.





Walter Lee Chemical Corp.

Complex parts *can be molded of TFE in spite of the lack of thermoplastic behavior of the material.*

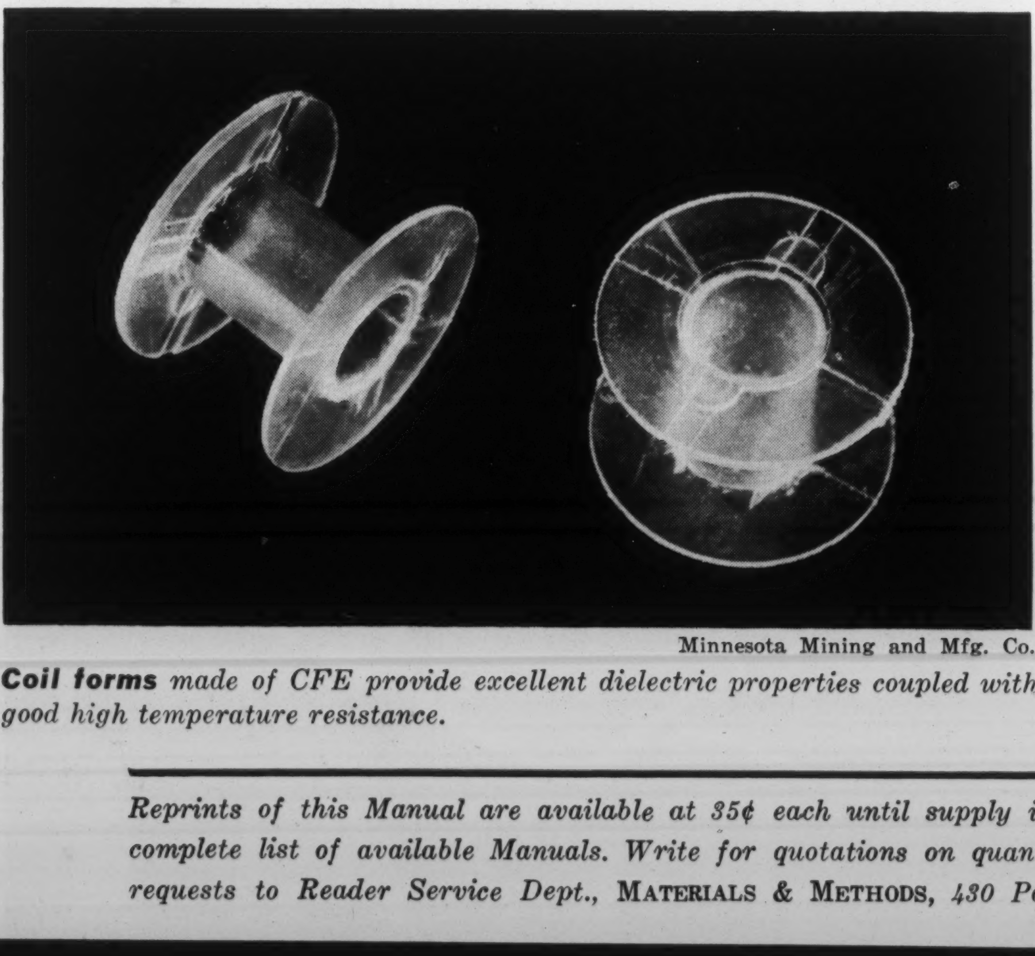
ings can be coated successfully with both TFE and CFE.

Where the protective qualities of fluorocarbons are required but coatings will not suffice because of mechanical considerations, fluorocarbon laminates can be applied. A CFE-glass cloth laminate has been developed recently, particularly for protective lining applications. Penetration of the glass cloth by the CFE resin is such that there is a continuous CFE surface on one side, and there is sufficient glass cloth surface on the other side to make possible a good adhesive bond.

A similar type of TFE-glass laminate has been developed for bonding to surfaces to provide antistick surface characteristics.

Techniques for applying such laminates to flat, curved or compound curvature surfaces have been well developed. The most success has been achieved using an epoxy-Buna N adhesive. Room temperature shear strengths of bonds between such laminates and steel, using Bondmaster NN48B adhesive (Rubber & Asbestos Corp.) range from 1000 to 4300 psi, depending on time and temperature of the cure.

These laminates can be applied to flat sheet metal, which can subsequently be drawn and stretched to a substantial degree by hot or cold forming. The degree of forming is limited primarily by the glass reinforcement. For relatively severe draws, such as might be encountered in manhole openings, outlets and flanges, hot forming is required. In such cases, the glass in the area to be formed is removed to permit flow of the plastic. The unreinforced and formed area is then lapped over adjacent reinforced areas and heat bonded.



Minnesota Mining and Mfg. Co.

Coil forms *made of CFE provide excellent dielectric properties coupled with good high temperature resistance.*

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Acknowledgments

The assistance of literature and personnel of the following companies is gratefully acknowledged:

Acme Resin Corp.
Allied Chemical and Dye Corp., General Chemical Div.
Bakelite Co., Div. of Union Carbide Corp.
Chicago Rawhide Mfg. Co.
Crane Packing Co.
Dixon Corp.
E. I. du Pont de Nemours & Co., Inc.
Haveg Industries, Inc., Halocarbon Div.
Minnesota Mining and Mfg. Co., Jersey City Chemical Div.
Raybestos-Manhattan, Inc., Plastic Products Div.
Resistoflex Corp.
Tri-Point Plastics, Inc.

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Cast Heat Resistant Alloys—Materials Data Sheet

Type -->	HA	HC	HD	HE	HF
COMPOSITION, %	C 0.20 max, Mn 0.35-0.65, Si 1.00 max, P 0.04 max, S 0.04 max, Mo 0.90-1.20, Cr 8-10	C 0.50 max, Mn 1.00 max, Si 2.00 max, P 0.04 max, S 0.04 max, Mo 0.5 max, Cr 26-30, Ni 4 max	C 0.50 max, Mn 1.50 max, Si 2.00 max, P 0.04 max, S 0.04 max, Mo 0.5 max, Cr 26-30, Ni 4-7	C 0.20-0.50, Mn 2.00 max, Si 2.00 max, P 0.04 max, S 0.04 max, Mo 0.5 max, Cr 26-30, Ni 8-11	C 0.20-0.40, Mn 2.00 max, Si 2.00 max, P 0.04 max, S 0.04 max, Mo 0.5 max, Cr 19-23, Ni 9-12
PHYSICAL PROPERTIES					
Density, lb/cu in.	0.279	0.272	0.274	0.277	0.280
Melting Point, F	2750	2725	2700	2650	2550
Ther Cond (212 F), Btu/hr/sq ft/ft/°F	15.2	12.6	12.6	10.0[b]	9.0
Coef of Exp (70-1200 F), per °F	7.5×10^{-6}	6.4×10^{-6}	8.0×10^{-6}	9.9×10^{-6}	10.1×10^{-6}
Spec Ht (70 F), Btu/lb/°F	0.11	0.12	0.12	0.14	0.12
Elec Res (70 F), microhm-cm	70	77	81	85	80
Magnetic Permeability	Ferromagnetic	Ferromagnetic	Ferromagnetic	1.3-2.5	1.0
MECHANICAL PROPERTIES					
Mod of Elast in Tension, psi	29×10^6	29×10^6	27×10^6	25×10^6	28×10^6
Tensile Strength, 1000 psi[a]:	95[d]/107[a]	70-110/115[c]	85/-	95/90	85/100[c]
Yield Strength (0.2% offset) 1000 psi	65[d]/81[d]	65-75/80[c]	48/-	45/55[c]	45/50[c]
Elongation (2 in.), %[a]	23/21[b]	2-19/18[c]	16/-	20/10[c]	35/25[c]
Brinell Hardness[a]	180[d]/220[a]	190-223/-	190/-	200/270[c]	165/190[c]
ELEVATED TEMPERATURE PROPERTIES					
Tensile Strength, 1000 psi	67 (1000 F), 44 (1100 F)	—	36 (1400 F), 23 (1600 F), 15 (1800 F)	—	57 (1200 F), 35 (1400 F), 22 (1600 F),
Yield Strength (0.2% offset), 1000 psi	42 (1000 F), 32 (1100 F)	—	—	—	21 (1400 F)
Elongation (2 in.), %	36 (1100 F)	—	14 (1400 F), 18 (1600 F), 40 (1800 F)	—	16 (1200 F), 20 (1400 F), 22 (1600 F)
Creep Strength (0.0001%/hr), 1000 psi	16 (1000 F), 7.2 (1100 F), 3.1 (1200 F)	1.3 (1400 F), 0.75 (1600 F), 0.36 (1800 F)	3.5 (1400 F), 1.9 (1600 F), 0.9 (1800 F)	4.0 (1400 F), 2.4 (1600 F), 1.4 (1800 F)	13 (1200 F), 6.0 (1400 F), 3.2 (1600 F)
Rupture Strength, 1000 psi					
10 hr	45 (1000 F)	4.6 (1400 F) 2.0 (1600 F), 1.1 (1800 F)	14 (1400 F)	—	37 (1200 F), 20 (1400 F), 10 (1600 F)
100 hr	37 (1000 F)	3.3 (1400 F), 1.7 (1600 F), 0.85 (1800 F)	10 (1400 F), 5 (1600 F), 2.5 (1800 F)	11 (1400 F), 5.3 (1600 F), 2.5 (1800 F)	30 (1200 F), 14 (1400 F), 6.0 (1600 F)
1000 hr	27 (1000 F)	2.3 (1400 F), 1.3 (1600 F), 0.62 (1800 F)	7 (1400 F)	—	17 (1200 F), 8.0 (1400 F), 3.8 (1600 F)
FABRICATING PROPERTIES					
Annealing Temperature, F	1625	—	—	—	1900[e]
Machinability	Fair	Good	Good	Good	Good
Weldability	Weldable by all common methods Preheating, postheating desirable		Preheating not required		
USES	Fan blades, furnace rollers, Lehr rolls, refinery fittings, trunnions	Grate bars, dampers, kiln parts, rabble blades, salt pots, tuyeres	Brazing furnace parts, cracking equipment, furnace blowers, pouring spouts, salt pots, gas burner parts	Billet skids, burner nozzles, furnace conveyors, tube supports, soot blower elements	Electrode arms, burner tips, annealing boxes, wear plates, gas burner rings, conveyor belts, dampers

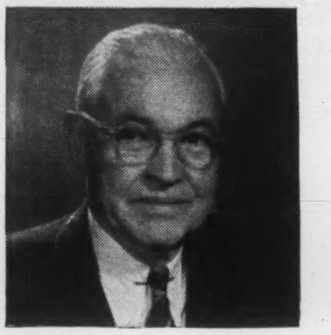
---

[a] As cast and heat treated values given in that order. [b] Normalized at 1825 F, tempered at 1250 F. [c] Aged 24 hr at 1400 F, furnace cooled. [d] Annealed. [e] Before cyclic temperature service, 6 hr at 1900 F may improve life. [f] At 1500 F.

◀ For more information, Circle No. 519

RB&W FASTENER BRIEFS

RUSSELL, BURDSALL & WARD BOLT AND NUT COMPANY



Technical-ities

By John S. Davey

Nuts — their use and abuse

With bolts tightened to high load levels, nut performance becomes critical.

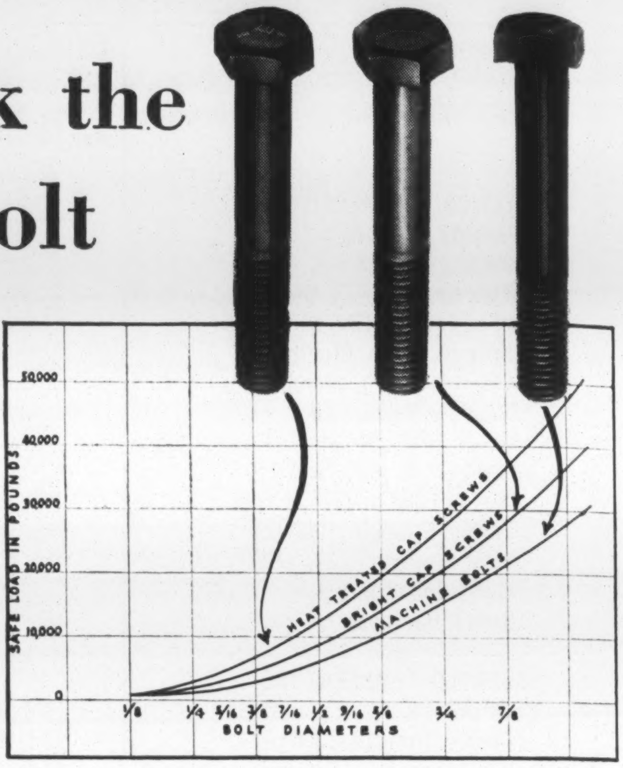
A nut produces bolt tension by rotating and advancing on the bolt threads. To do this, there must be a mating condition of threads, which is influenced by thread lead. Lead is a matter of tolerance only before bolt is stressed. When tightened, the nut is then under compression and threads tend to contract; the bolt is in tension, and threads tend to stretch. Lead of thread is affected–elastically *before* yield point, permanently *beyond* it.

This shortening of one lead and lengthening of the other has two effects. (1) The load distributes unequally along the threads (2) Torsion on bolt increases. Something has to give. For high tensile bolts especially, it is better for the nut to do so. A nut therefore should be soft enough so that it deforms plastically and compensates for off-lead. If it does, it *distributes* the load and can advance to increase tension.

"SOFT" NUTS DO MOST JOBS

"Soft" nuts do adjust more readily than hard ones under these severe conditions. While such nuts may not be as strong in shear as heat treated ones, the important point is the bolt tension they produce. As long as the nut can pull the bolt well into its plastic range, it is doing more than its share of the job.

How to pick the right size bolt



When it comes to uniformity of dimension, quality of head and thread, and ease of assembly, all RB&W cold headed fasteners are the same. They differ mainly in tensile strength as shown here.

ALMOST all bolt and cap screw strength requirements can be satisfied from three types of *standard* fasteners without recourse to costly special alloys. In the widely used middle range of sizes, the problem is one of deciding which makes the best joint, or which proves the most economical for the job.

MORE FOR LESS

Suppose, for example, you need a bolt safe for 20,000 pounds of loading. As the chart shows, you could use an RB&W 7/8″ square-head bolt, a 3/4″ bright cap screw, or a 5/8″ heat treated one.

If you have a lot of holes to fill, use the larger, lower strength fasteners. But to cut down number of bolts, or their size (and therefore cost), go to the higher tensiles. However you gain nothing if you don't tighten high tensile bolts to their full strength.

HOW COSTS COMPARE

In terms of holding power: For each $1.00 in high tensile bolts, it costs $1.50 to provide equivalent clamping force with bright cap screws; or $1.65 with machine bolts.

For more suggestions on fastener economy or for copy of above curves, write Russell, Burdsall & Ward Bolt and Nut Company, Port Chester, N.Y.

Plants at: Port Chester, N. Y.; Coraopolis, Pa.; Rock Falls, Ill.; Los Angeles, Calif. Additional sales offices at: Ardmore (Phila.), Pa.; Pittsburgh; Detroit; Chicago; Dallas; San Francisco.

Spin-Lock Nuts dig in to stay tight

The photograph shows the many hardened "anchors" on the flange of a Spin-Lock Nut. These "ratchet-action" teeth require 20% more torque to loosen than to tighten. They bite in as the nut turns down on its seat. Like Spin-Lock Screws, these nuts can stay put in products subject to vibration and cyclic temperature variations. Send for bulletin.

For more information, turn to Reader Service Card, Circle No. 436

Cast Heat Resistant Alloys—continued

Type →	HH		HI	HK	HL
COMPOSITION, %	C 0.20-0.50, Cr 24-48, Mn 2.00 max, Ni 11-14, Si 2.00 max, P 0.04 max, S 0.04 max, Mo 0.5 max, N 0.2 max		C 0.20-0.50, Mn 2.00 max, Si 2.00 max, P 0.04 max, S 0.04 max, Mo 0.5 max, Cr 26-30, Ni 14-18	C 0.20-0.60, Mn 2.00 max, Si 2.00 max, P 0.04 max, S 0.04 max, Mo 0.5 max, Cr 24-28, Ni 18-22	C 0.20-0.60, Mn 2.00 max, Si 2.00 max, P 0.04 max, S 0.04 max, Mo 0.5 max, Cr 28-32, Ni 18-22
PHYSICAL PROPERTIES					
Density, lb/cu in.	0.279		0.279	0.280	0.279
Melting Point, F	2500		2550	2550	2600
Ther Cond (212 F), Btu/hr/sq ft/ft/°F	8.2		10.9	8.2	8.2
Coef of Exp (70-1800 F) per °F	10.5×10^{-6}		10.5×10^{-6}	10.0×10^{-6}	9.9×10^{-6}
Spec Ht (70 F), Btu/lb/°F	0.12		0.12	0.12	0.12
Elec Res (70 F), microhm-cm	75-85		—	90	94
Magnetic Permeability	1.0-1.9		1.0-1.7	1.02	1.01
	Type I[h]	Type II[i]			
MECHANICAL PROPERTIES					
Mod of Elast in Tension, psi	27×10^6	27×10^6	27×10^6	29×10^6	29×10^6
Tensile Strength, 1000 psi[g]	80/86	85/92	80/90	75/85	82/-
Yield Strength, 1000 psi[g]	50/55	40/45	45/65	50/50	52/-
Elongation (2 in.), %[g]	25/11	15/8	12/6	17/10	19/-
Brinell Hardness[g]	185/200	180/200	180/200	170/190	192/-
ELEVATED TEMPERATURE PROPERTIES					
Tensile Strength, 1000 psi					
1400 F	33	35	38	—	50
1600 F	18.5	22	26	23	30
1800 F	9.0	11	—	—	19
Yield Strength (0.2% offset), 1000 psi					
1400 F	17	18	—	—	—
1600 F	13.5	14	—	—	—
1800 F	6.3	7.0	—	—	—
Elongation (2 in.), %					
1400 F	18	12	6	—	—
1600 F	30	16	12	21	—
1800 F	45	30	—	—	—
Creep Strength (0.0001%/hr), 1000 psi					
1400 F	3.0	7.0	6.6	6.8	7.0
1600 F	1.7	4.0	3.6	4.2	4.3
2001 F	0.3	0.8	0.8	1.0	—
2150 F	—	—	0.15	0.2	—
Rupture Strength, 1000 psi					
10 hr 1400 F	—	20	—	23	—
10 hr 1600 F	—	10	—	11	—
10 hr 1800 F	4.7	6.0	—	6.5	—
100 hr 1400 F	14	14	13	14.5	15
100 hr 1600 F	6.4	7.5	7.5	7.8	9.2
100 hr 2000 F	1.5	1.8	1.9	2.5	—
1000 hr 1400 F	6.5	10	8.5	9.0	—
1000 hr 1600 F	3.8	4.7	4.8	5.0	—
1000 hr 2000 F	—	1.2	1.2	—	—
FABRICATING PROPERTIES					
Annealing Temperature, F	1900[d]	1900[d]	—	—	—
Machinability	Fair	Fair	Fair	Good	Good
Weldability	Weldable by all common methods; no preheat or postheat required				
USES	Annealing trays, tube supports, carburizing boxes, exhaust manifolds, radiant tubes, retorts, stoker parts		Billet skids, brazing fixtures, furnace rails, lead pots, tube spacers, retorts	Heat treating fixtures, rabble arms, retorts, brazing fixtures, skid rails, furnace door parts	Carrier fingers, enameling furnace fixtures, furnace skids, stack dampers

[g] **As cast and heat treated (aged 24 hr at 1400 F, furnace cooled) values given in that order.** [h] **Partially ferritic.** [i] **Austenitic.**

THIS IS THE FAHRALLOY TRADEMARK

it stands for nearly a quarter century of

QUALITY
SERVICE
INTEGRITY

look for it on the heat and corrosion resistant alloy castings you buy—

Your own experience will more than justify your confidence in products that bear the FAHRALLOY trademark

the fahralloy co.
150th & Lexington Ave. - Harvey, Illinois
In Canada - Fahralloy Canada, Ltd., Orillia, Ontario

For more information, turn to Reader Service Card, Circle No. 465

Cast Heat Resistant Alloys—continued

Type →	HN	HT	HU	HW	HX
COMPOSITION, %	C 0.20-0.50, Mn 2.00 max, Si 2.00 max, P 0.04 max, S 0.04 max, Mo 0.5 max, Cr 19-23, Ni 23-27	C 0.35-0.75, Mn 2.00 max, Si 2.50 max, P 0.04 max, S 0.04 max, Mo 0.5 max, Cr 13-17, Ni 33-37	C 0.35-0.75, Mn 2.00 max, Si 2.50 max, P 0.04 max, S 0.04 max, Mo 0.5 max, Cr 17-21, Ni 37-41	C 0.35-0.75, Mn 2.00 max, Si 2.50 max, P 0.04 max, S 0.04 max, Mo 0.5 max, Cr 10-14, Ni 58-62	C 0.35-0.75, Mn 2.00 max, Si 2.50 max, P 0.04 max, S 0.04 max, Mo 0.5 max, Cr 15-19, Ni 64-68
PHYSICAL PROPERTIES					
Density, lb/cu in.	0.283	0.286	0.290	0.294	0.294
Melting Point, F	2500	2450	2450	2350	2350
Ther Cond (212 F), Btu/hr/sq ft/ft/°F	—	7.7	—	7.7	—
Coef of Exp (70-1800 F), per °F	—	9.8×10^{-6}	9.6×10^{-6}	8.8×10^{-6}	9.2×10^{-6}
Spec Ht (70 F), Btu/lb/°F	0.11	0.11	0.11	0.11	0.11
Elec Res (70 F), microhm-cm	—	100	105	112	—
Magnetic Permeability	1.10	1.10-2.00	1.10-2.00	16.0	2.0
MECHANICAL PROPERTIES					
Mod of Elast in Tension, psi	27×10^{6}	27×10^{6}	27×10^{6}	25×10^{6}	25×10^{6}
Tensile Strength, 1000 psi[a]	68/-	70/75[j]	70/73[k]	68/84[l]	65/73[k]
Yield Strength, 1000 psi[a]	38/-	40/45[j]	40/43[k]	36/52[l]	36/44[k]
Elongation (2 in.), %[a]	17/-	10/5[j]	9/5[k]	4/4[l]	9/9[k]
Brinell Hardness[a]	160/-	180/200[j]	170/190[k]	185/205[l]	176/185[k]
ELEVATED TEMPERATURE PROPERTIES					
Tensile Strength, 1000 psi					
1400 F	—	35	40	32	—
1600 F	—	18.8	19.6	19	20.5
1800 F	—	11	10.0	10	10.7
Yield Strength (0.2% offset), 1000 psi					
1400 F	—	26	—	23	—
1600 F	—	15	—	15	17.5
1800 F	—	8.0	6.2	8.0	6.9
Elongation (2 in.), %					
1400 F	—	10	—	—	—
1600 F	—	26	20	—	48
1800 F	—	28	28	40	40
Creep Strength (0.0001%/hr), 1000 psi					
1400 F	—	8.0	8.5	6.0	6.4
1600 F	6.3	4.5	5.0	3.0	3.2
2000 F	0.9	0.5	0.6	—	0.6
2150 F	—	0.15	—	—	—
Rupture Strength, 1000 psi					
10 hr 1400 F	—	—	—	16	18
10 hr 1600 F	—	11	—	8.2	10
10 hr 2000 F	—	—	—	—	2.5
100 hr 1400 F	—	18	15	10	13
100 hr 1600 F	9.5	8.5	8.0	6.0	6.7
100 hr 2000 F	2.5	2.5	—	—	1.7
1000 hr 1400 F	—	12.5	—	7.8	—
1000 hr 1600 F	6.5	7.0	6.0	4.5	4.0
1000 hr 2000 F	0.9	1.8	—	—	0.9
FABRICATING PROPERTIES					
Annealing Temperature, F	—	1900[d]	1900[d]	—	—
Machinability	Good	Good	Good	Good	Good
Weldability	Weldable by all common methods; no preheat or postheat required				
USES	Brazing fixtures, chain, nozzles, furnace parts, radiant tubes, tube supports	Air ducts, carburizing boxes, cyanide pots, glass molds, lead pots, oil burner nozzles	Articulated trays, burner tubes, lead pots, cyanide pots, muffles	Cyanide pots, gas retorts, electric heating elements, hearth plates	Autoclaves, calciner tubes, furnace parts, salt bath electrodes, muffles

[j] Aged 24 hr at 1400 F, air cooled. [k] Aged at 1400 F, furnace cooled [l] Aged 48 hr at 1800 F, furnace cooled.

Compiled from ACI Data Sheets recently published by Alloy Casting Institute

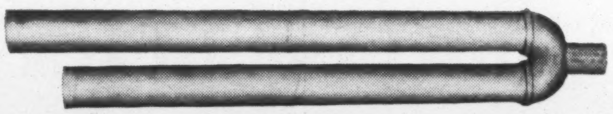
THERMALLOY*

...THE RIGHT WORD FOR LONG-LIFE ECONOMY IN HEAT-RESISTANT CASTINGS

First cost is only one factor in the operating economy of high-heat-resistant castings. Extra service life, obtained through the *right* combination of physical properties and casting techniques, is a much sounder gauge of over-all economy.

That's why more and more heat-treat operators are specifying Thermalloy Radiant Tubes, Retorts, Trays, Pots and other heat-treat parts. We'd be glad to show you service life case histories to *prove* their long-life economy. Contact your nearby Electro-Alloys representative, or write for the technical bulletins listed below . . . Electro-Alloys Division, 8026 Taylor Street, Elyria, Ohio.

*Reg. U. S. Pat. Off.

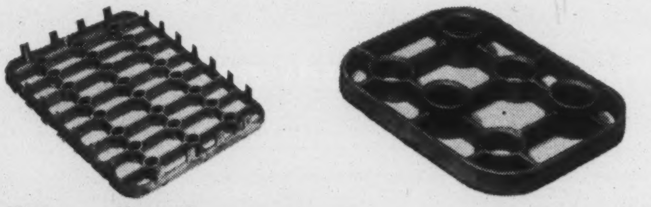


Thermalloy Radiant Tubes

Centrifugally cast to insure uniform wall thickness; pressure tested to assure freedom from leakage; X-ray controlled to guarantee soundness. *Write for Centrifugal Casting Bulletin T-283.*

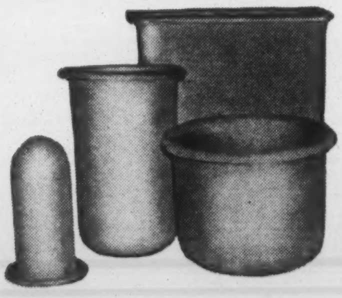
Thermalloy Retorts

Octagonal, pit-type, annealing and spiral retorts—plus baskets and spiders. Special designs and grades of Thermalloy to meet your specifications. *Write for Bulletin T-239.*



Thermalloy Trays

Experienced design know-how and casting techniques, plus Thermalloy's outstanding physical properties, mean extra service life and economy. *Write for Bulletin T-227.*



Thermalloy Heat-Treat Pots

A wide range of standard sizes, or "specials" to meet your needs—all cast of long-lasting Thermalloy heat-resistant alloys. X-ray inspected, pressure tested. *Write for Bulletin T-234.*

AMERICAN Brake Shoe COMPANY **ELECTRO-ALLOYS DIVISION** Elyria, Ohio

For more information, turn to Reader Service Card, Circle No. 381

What's new IN MATERIALS

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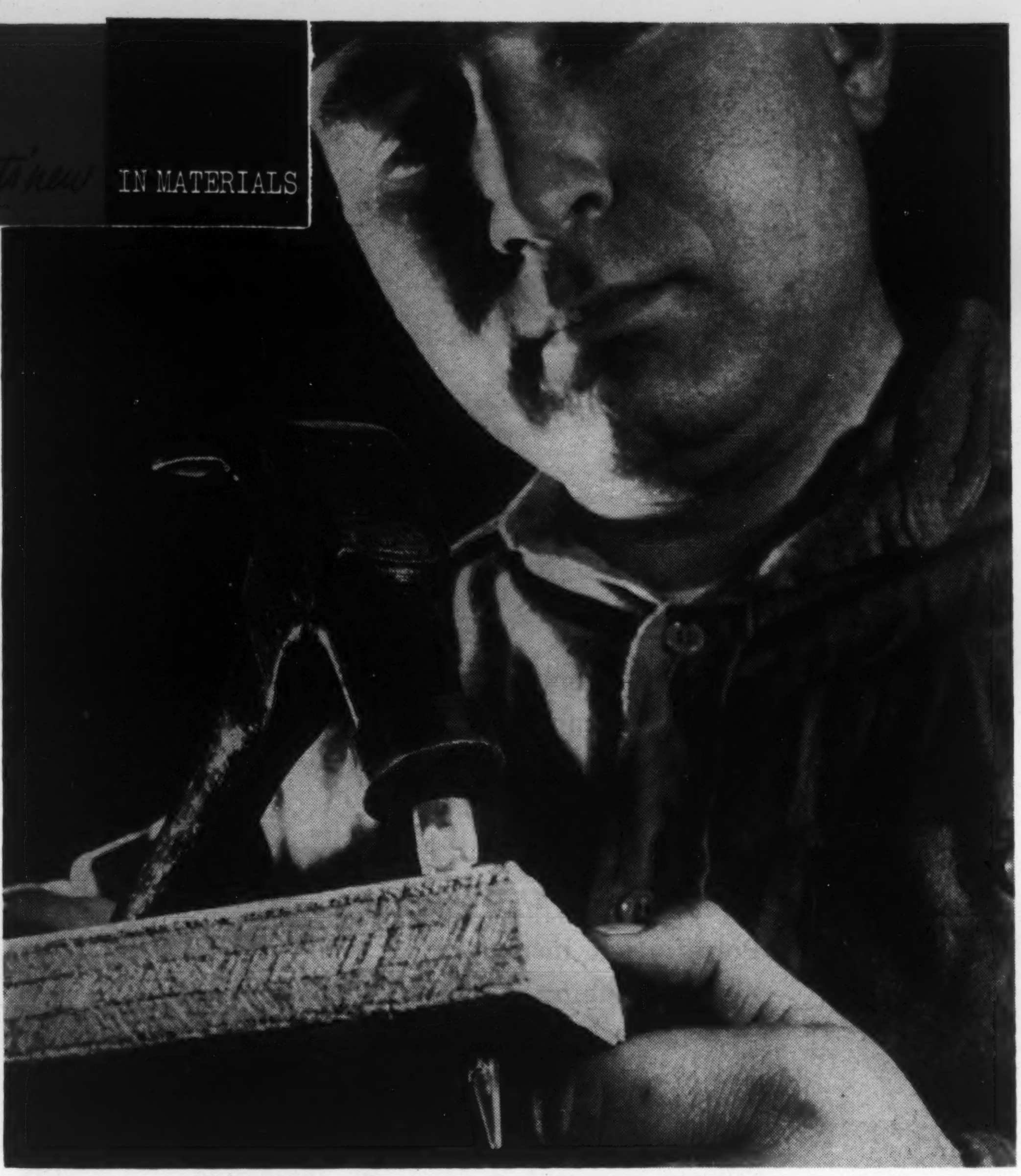
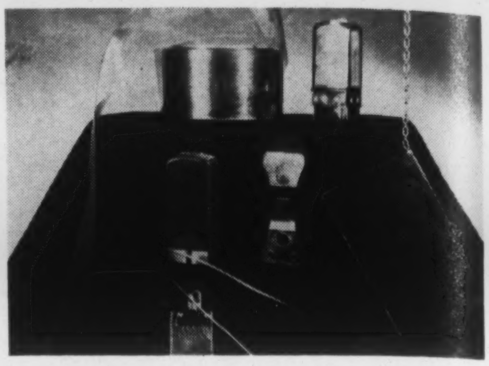


Molded polycarbonate spike *is driven through a number of layers of plywood to show its extreme toughness.*



Experimental forms *of new polycarbonate resin include flat extruded film, clear and colored injection moldings, compression molded test bars, flat sheet, fluidized-bed coatings and extruded wire coverings.*

PROPERTIES OF MOLDED LEXAN RESIN

Notched Izod Impact Strength, ft lb/in.	14
Tensile Impact, ft lb/cu in.	600-900
Tensile Yield Strength, psi	8000-9000
Tensile Strength, psi	9000-10,500
Elongation, %	60-100
Flexural Strength, psi	11-13,000
Water Absorption (24 hr), %	0.3
Rockwell Hardness	M70
Specific Gravity	1.20
Arc Resistance, sec	100-140
Dielectric Strength (short time), v/mil	400
Dielectric Constant	
60 cycles	2.80
1 mc	2.85
Power Factor	
60 cycles	0.009
1 mc	0.0095
Volume Resistivity, ohm-cm	6×10^{15}
Heat Distortion Temperature (264 psi), F	285
Mold Shrinkage, in./in.	0.006
Thermal Conductivity, Btu/hr/ft^2/F/ft	0.11
Coef of Ther Exp, in./in./F	3.9×10^{-5}
Melting Point (crystalline), F	514

Tough, New Polycarbonate Resin May Find Use As Film, Housings

■ Work at General Electric's Research Laboratory, Schenectady, N. Y., indicates that a polycarbonate resin, called Lexan, is tough enough to replace cast metals, ceramics and other plastics in some applications. Walls of parts made from the new compound are reported to be strong enough to withstand repeated blows of a carpenter's hammer.

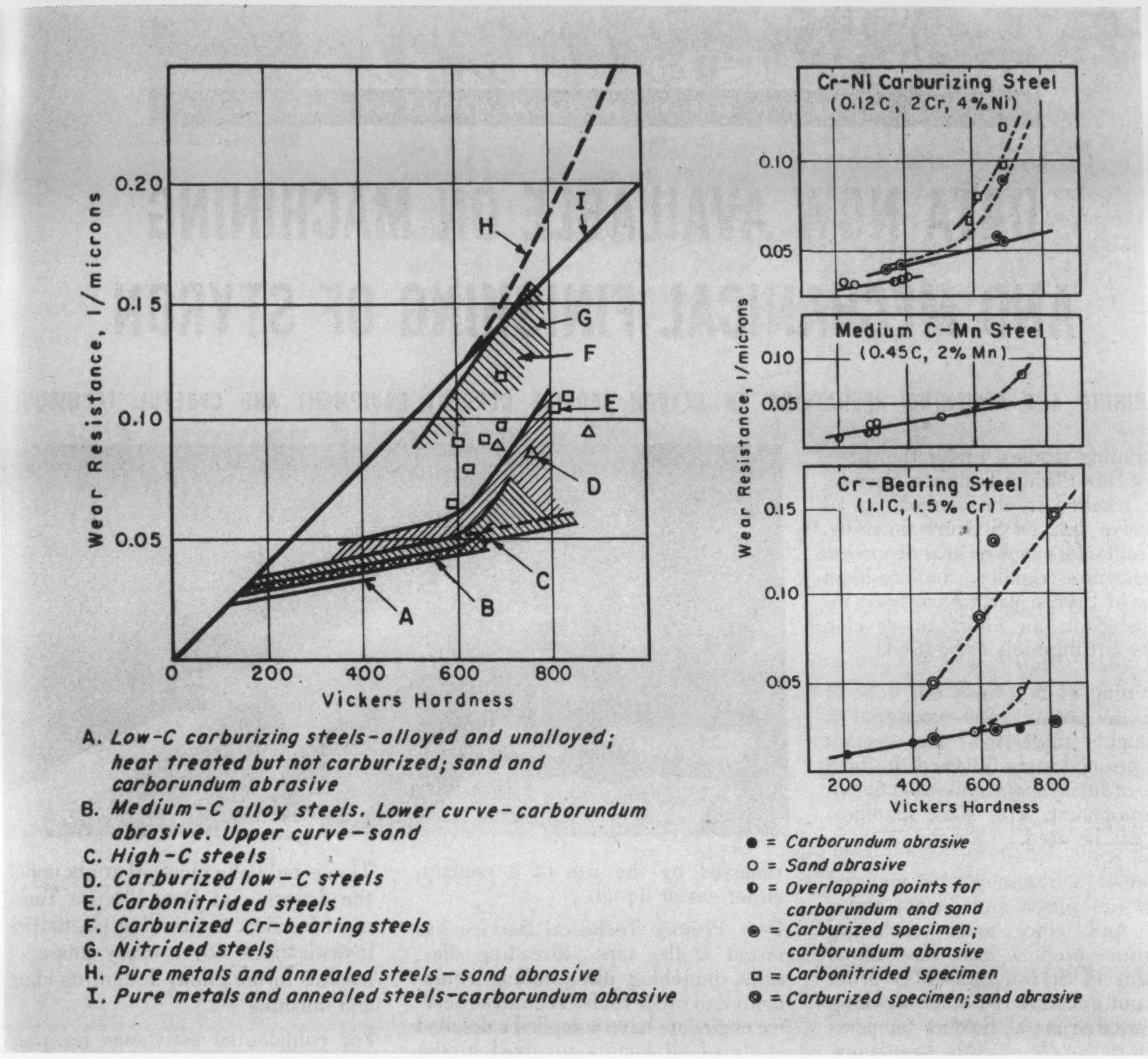
Not yet commercially available, GE's polycarbonate resin is similar to a polycarbonate resin developed by Bayer in Germany. Although both firms have worked independently of each other in developing the resin, they are presently discussing joint licensing agreements on producing the material. It is rumored that a third party has developed a polycarbonate resin, but at present no details are available.

Though costs of raw materials used in producing the resin are relatively high, GE hopes soon to develop a family of polycarbonate molding resins. Molding temperatures of the resin are said to be in the range of nylon (500-550 F).

Continuing studies of the resin in the form of molding and extrusion compounds, film, varnish and coatings at the company's Pittsfield, Mass., laboratories indicate that it can be made in a variety of transparent and opaque colors, with cured parts showing good surface hardness and gloss.

According to Dr. A. E. Schubert, manager of the company's Chemical Development Dept., "the material offers an unusual combination of toughness, impact strength, heat resistance and dimensional stability. These properties make it promising for applications not previously handled by conventional thermoplastic materials."

The new material is expected to be useful for such applications as coil forms, decorative and functional appliance parts, gears, automotive parts, housings, structural parts and electrical insulation.



A. *Low-C carburizing steels-alloyed and unalloyed; heat treated but not carburized; sand and carborundum abrasive*
B. *Medium-C alloy steels. Lower curve-carborundum abrasive. Upper curve-sand*
C. *High-C steels*
D. *Carburized low-C steels*
E. *Carbonitrided steels*
F. *Carburized Cr-bearing steels*
G. *Nitrided steels*
H. *Pure metals and annealed steels-sand abrasive*
I. *Pure metals and annealed steels-carborundum abrasive*

● = *Carborundum abrasive*
○ = *Sand abrasive*
◐ = *Overlapping points for carborundum and sand*
◉ = *Carburized specimen; carborundum abrasive*
□ = *Carbonitrided specimen*
◎ = *Carburized specimen; sand abrasive*

Relationship Predicts Abrasive Resistance of Steel

■ The most important reason for discrepancies between test results and actual in-service wear resistance is the difference between abrasive hardness and metal hardness. M. M. Tenenbaum, in the Aug '56 issue of *Vestnik Mashinostroyeniya* (Russian), discusses this factor in connection with a new test for evaluating abrasive wear resistance.

On the basis of tests made on 21 types of steel with varying heat treatments and surface treatments, he found that the ratio of Vickers hardness of steel to Vickers hardness of abrasive is a governing factor in determining the relative rating of steels. If this ratio is under 0.5 to 0.6, wear resistance does not depend on the abrasive hardness; therefore, these values can be considered as one of the characteristic properties of steels. Under these circumstances abrasive wear resistance increases gradually and practically linearly with steel hardness.

With a softer abrasive (when the ratio is over 0.5 to 0.6), the effect of increasing steel hardness in improving abrasive wear resistance is much more pronounced. For example, increasing the hardness of carburized steel from 500 to 700 Vickers increases the wear resistance vs carborundum by 22%; but the same increase in steel hardness increases the wear resistance vs sand by about five times. This relationship has been borne out by service results obtained in the coal industry.

Hardness values being equal, carbon content of the steel is the major factor influencing abrasive wear resistance. The higher the carbon content, the better the wear resistance. Alloying elements have no significant effect (al-

JUNE
1957

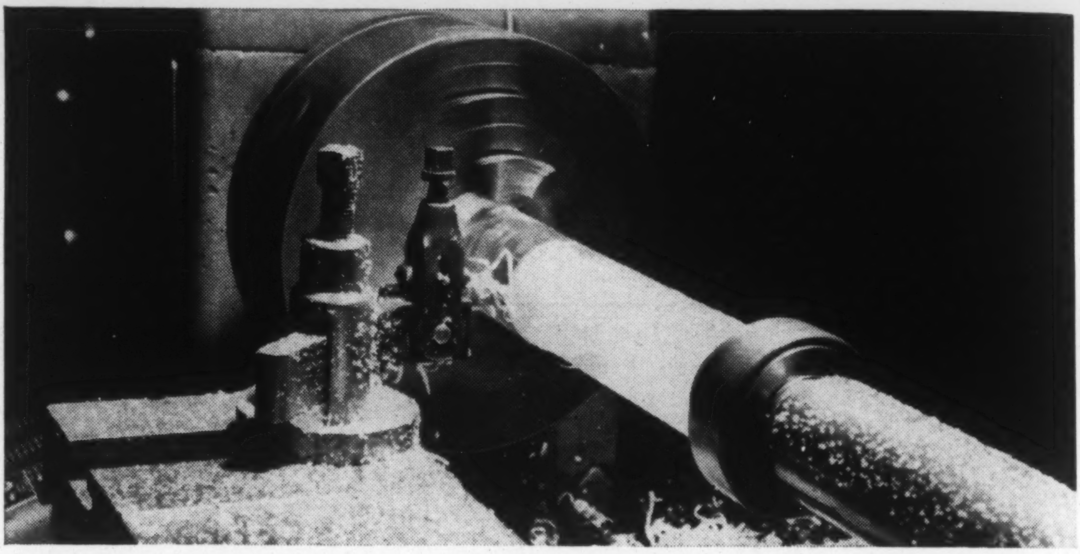
DOW

Plastiatrics

DOW'S CLINICAL APPROACH TO HEALTHY PLASTICS APPLICATION

DATA NOW AVAILABLE ON MACHINING AND MECHANICAL FINISHING OF STYRON

MACHINING AND FINISHING OPERATIONS ON STYRON REQUIRE CORRECT EQUIPMENT AND CAREFUL TECHNIQUES



Continuing studies, under the direction of Dow Plastics Technical Service, have resulted in the compilation of extensive data on Styron® finishing. Critical factors such as heat distortion temperature, rigidity, and residual stress of Styron parts have been investigated in an effort to develop proper cutting tools to be used.

Machining of Styron is not difficult when the nature of the material is thoroughly understood and certain basic principles are followed. In most cases, ordinary metal and wood finishing equipment, with some modification, can be used.

Styron is a thermoplastic material which can soften and distort under heat. And, since most machining operations produce heat, mechanical finishing of Styron introduces problems not encountered when working with wood or metal. Surface temperature, for example, must be kept below 140°F. This may be accomplished by reducing friction and providing for proper chip clearance. In many cases, excessive heat generated must be removed by the use of a coolant, either gas or liquid.

Dow Plastics Technical Service has tested drills, taps, threading dies, saws, punching dies, buffing equipment and other tools. Technical Service engineers have compiled a detailed study of all factors involved in the machining and mechanical finishing of Styron parts, which you may obtain by writing for a copy of "Machining and Mechanical Finishing of Styron".

This is only one phase of study under the direction of Dow Plastics Technical Service. Continuing plastiatrics investigations cover every phase of plastics formulation, design, molding and finishing.

For confidential assistance on your plastics problem, and for detailed technical information, write today to THE DOW CHEMICAL COMPANY, Midland, Mich., Plastics Sales Dept. PL 1542H.

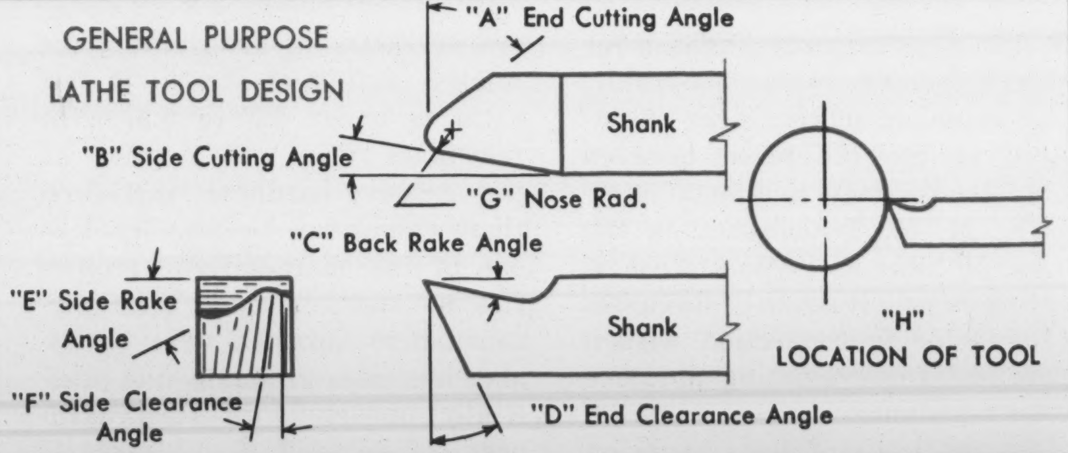
AMERICA'S FIRST FAMILY OF POLYSTYRENES

GENERAL PURPOSE
- STYRON 666
- STYRON 665 (Extrusion)
- STYRON 688 (Easy Flow)
- STYRON 689 (Easy Flow)

HIGH IMPACT
- STYRON 475
- STYRON 777 (Medium Impact)
- STYRON 440 (Heat Resistant)
- STYRON 480 (Extra-High Impact)

HEAT RESISTANT
- STYRON 683
- STYRON 700

GENERAL PURPOSE LATHE TOOL DESIGN



Mat'l.	A	B	C	D	E	F	G	H
Med. Steel	20°	10°	+8°	6°	14°	4°	3/16	At ℄
Polystyrene	20°	10°	−2°	12°	10°	10°	3/16	2° above ℄

YOU CAN DEPEND ON DOW

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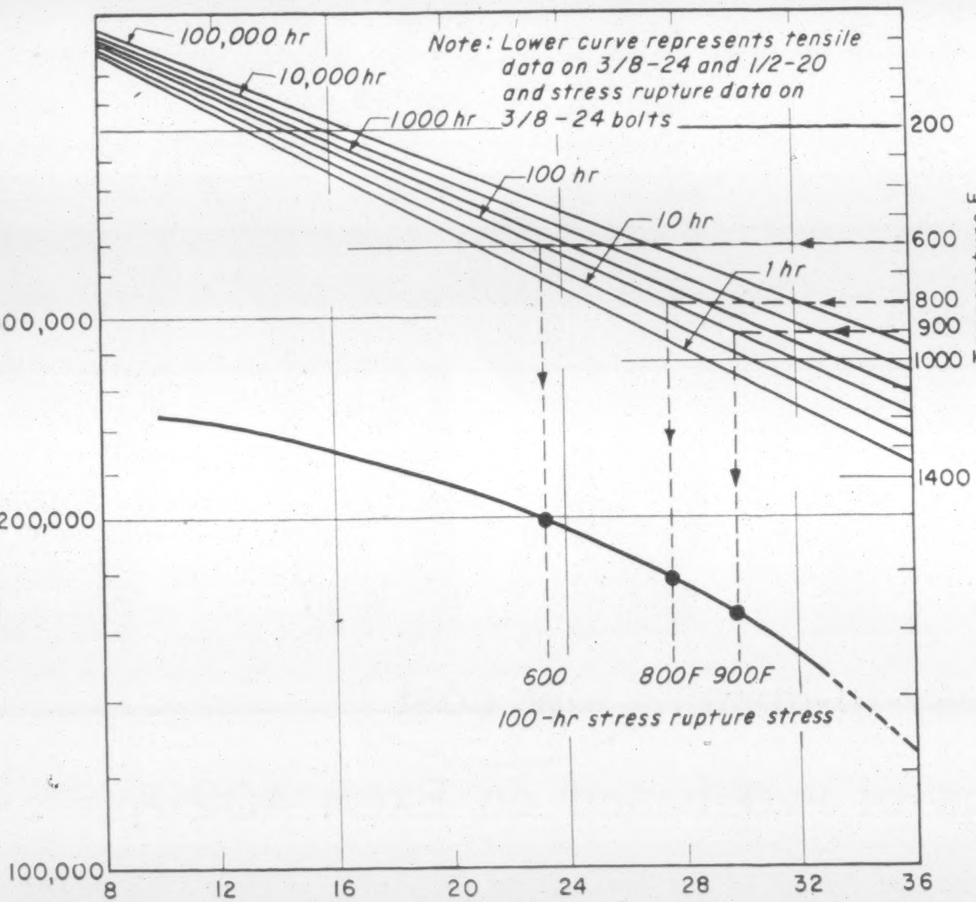
though, of course, they determine whether the desired hardness is obtained in large parts). Shot peening increases surface hardness but does not change abrasive wear resistance. Surface treatments, such as carburizing, carbonitriding, nitriding and chromizing, cause a sharp increase in abrasive wear resistance. Structure as well as hardness may be a factor; the presence of hard carbides in the case, for instance, produces a greater improvement in wear resistance than would be expected from the Vickers hardness.

Although the new relationships seem to answer many questions, more correlation with service is needed before accurate predictions concerning the wear of actual parts can be made.

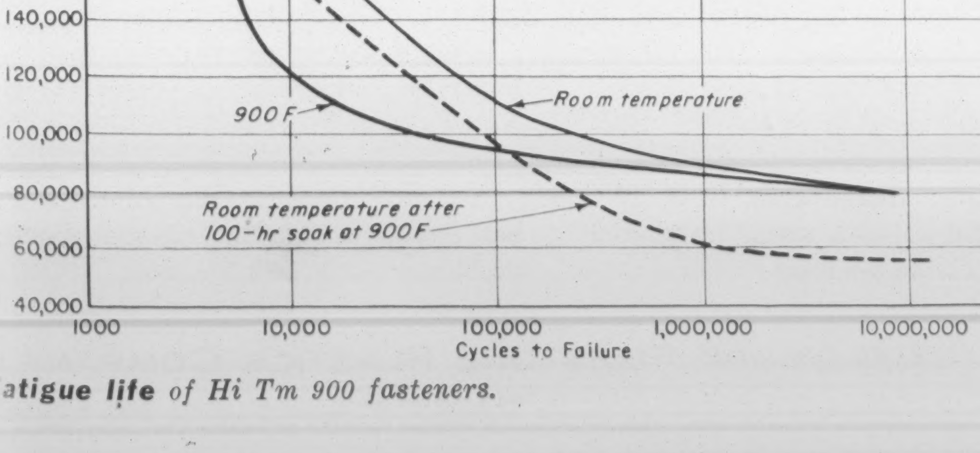
New Fastener Alloy Stays Strong at 900 F

■ What are claimed to be the "strongest fasteners at any temperature" are now available from Standard Pressed Steel Co., Box 796, Jenkintown, Pa. Called Hi Tm 900, the new fastener alloy is said to have properties at 900 F that are better than the minimum military specifications at room temperature for the strongest existing aircraft fastener.

The new alloy, Vascojet 1000, is a modification of a hot work die steel that has been available from Vanadium Alloys Steel Co. for



Stress-rupture chart *(Larsen-Miller curve) for Hi Tm 900 fasteners.*



Fatigue life *of Hi Tm 900 fasteners.*

COMPARISON OF TENSILE STRENGTH
(1000 psi)

	Hi Tm 900	AMS 5616	AMS 6304
Room Temp	220	145	145
800 F	190	105	123
900 F	170	95-100	110-120

MECHANICAL PROPERTIES OF HI TM 900

	Room Temp	Room Temp[a]	900 F
Ten Str, 1000 psi[b]	220	220	170
Yld Str (0.25% offset), 1000 psi[b]	185	185	140
Elong (in 4 in.), %[b]	10	10	16
Red of Area, %[b]	35	35	50
Shear Str, 1000 psi[b]	140	140	100
Stress-Rupture Str (100-hr life), 1000 psi	—	—	130
Fatigue Str (8000 cycles, 10% preload), 1000 psi	80	55	80
Impact Str, ft-lb	18	18	23

[a] Tested at room temperature after 100-hr soak at 900 F.

[b] Minimum.

PLANT ENGINEERS CUT LABOR TIME 75%
WITH NEW CORROSION-FREE DRAINAGE SYSTEM

Industry develops new easy-to-install low cost drainage pipes and fittings of PVC based on EXON 402-A

. . . another use typical of the Pin-Pointed Properties in Exon Vinyl resins

Tube Turn Plastics, Inc., timed a journeyman plumber as he made a bell and spigot joint in a 2″ Schedule 40 alloy cast iron line. *It took 3 minutes, 45 seconds.*

Then he joined a length of new 2″ Schedule 40 PVC pipe to a newly developed PVC socket type solvent welding drainage fitting. *Complete time: 56 seconds . . . a labor saving of 75%.*

This is one reason it is more economical to dispose of corrosive industrial liquid wastes with drainage systems of PVC based on Exon 402-A resin. Installation requires less labor per joint . . . fewer tools and materials . . . and fewer joints.

The new socket type drainage fitting eliminates troublesome corrosion pockets and gives you unimpeded flow conditions. It is unaffected by ground conditions, acid or alkaline, wet or dry. It is not subject to galvanic or electrolytic action.

Exon 402-A is just one resin in industry's most complete line of versatile vinyls. No wonder industry looks to Firestone for engineered answers to its needs.

For resin properties pin-pointed to the best answer to your own plant or product problems, check with Firestone.

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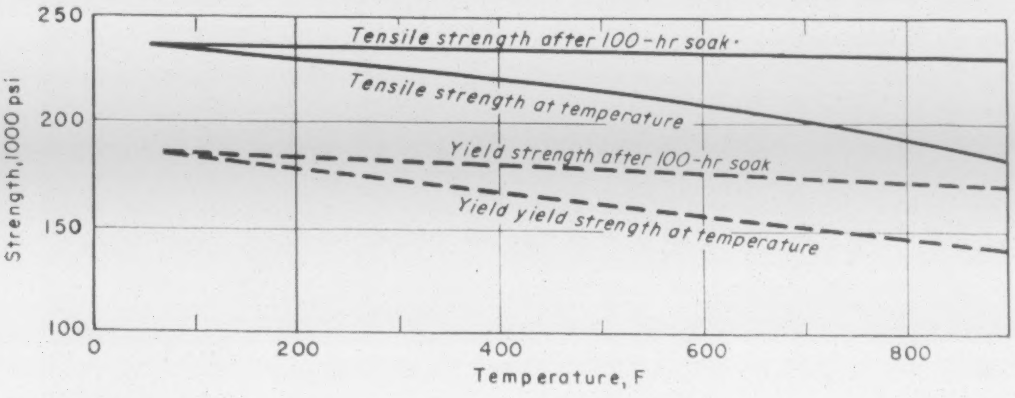


Tensile, yield and shear *strengths of Hi Tm 900 vs temperature.*

about 24 years. Composition of the alloy is 0.40 carbon, 0.5 vanadium, 1.30 molybdenum and 5.0% chromium. Chief significance of the development is that it allows the design of structures for Mach 3 flight (2100 mph) without fear of fasteners breaking down.

The fasteners are available in diameters from ¼ to 1½ in. Threads are cold formed after heat treatment. In order to provide corrosion resistance, diffused nickel-cadmium plating is used instead of conventional cadmium plating. (Cadmium melts at 600 F and diffuses into the bolt metal, causing embrittlement.) Nickel-cadmium plating is done by plating separate layers of nickel and cadmium; thermal treatment diffuses the two into an alloy which is claimed to be good up to 1000 F.

Alloy Steel Retains Hardness at High Temperature

■ A new low carbon bearing steel designed for use in the hot end of military jet engines has excellent hardness characteristics and requires no imported materials such as tungsten or cobalt. Developed by Republic Steel Corp. and made into bearings by Bower Roller Bearing Div., Federal-Mogul-Bower Bearings, Inc., the alloy has as its principal alloying elements 3 nickel, 1.5 chromium and 5% molybdenum (see accompanying table).

The principal reason for the alloy's development, according to O. W. McMullan, chief metallurgist at Bower, is that although "other alloy steels could prove suitable for jet engine bearings, many of them contain elements such as tungsten or cobalt, which must be imported to the United States. The new material matches the performance of such steels, while it reduces the possibility of scarcity."

In addition to eliminating the necessity for imported materials, the new alloy, called Bower 315, offers advantages of its own. Perhaps the most important are its hardness characteristics (see graph on p 164). Operating temperatures in jet engines range up to 500 F and, though steel ordinarily softens permanently at elevated temperatures, the new material recovers its original hardness when cooled even after heating as high as 1000 F.

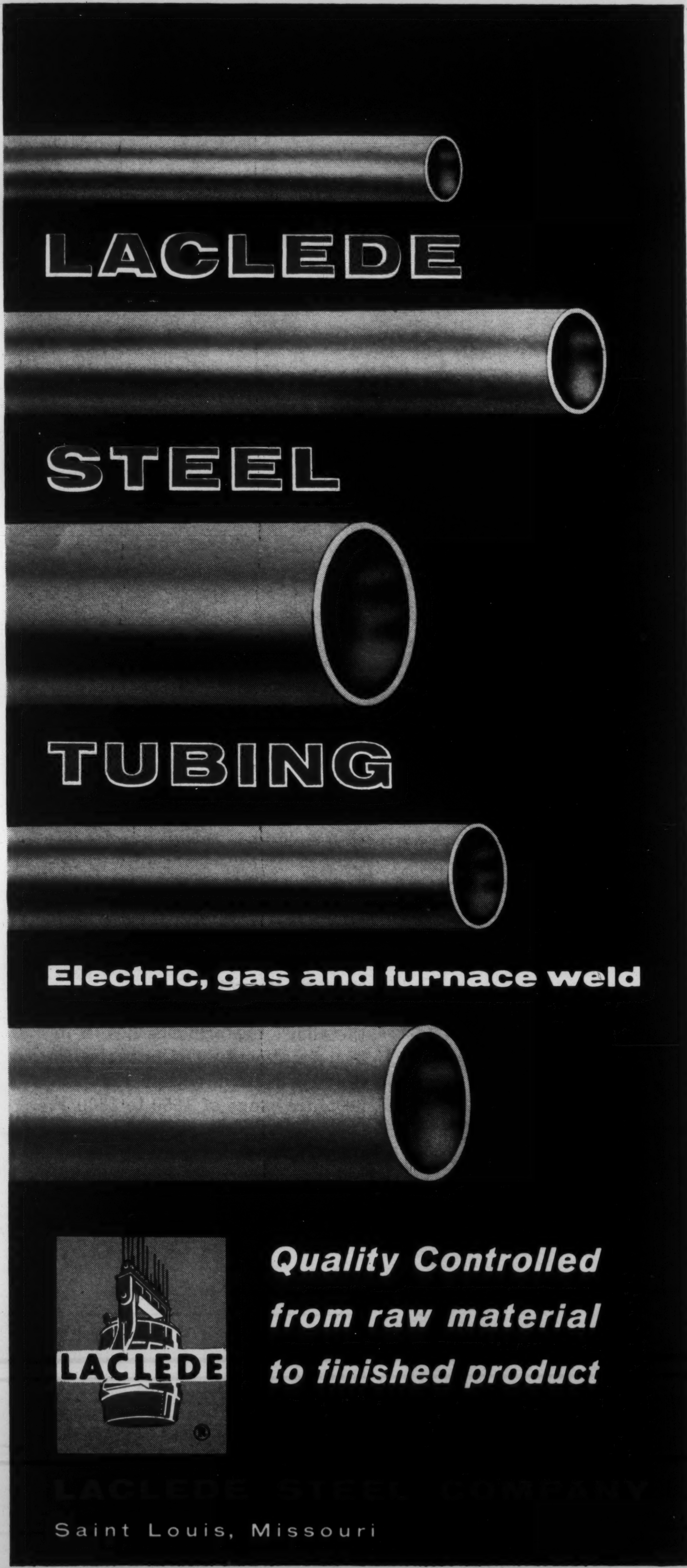
Heat treatment

According to Bower, the key to the alloy's performance lies in its heat treatment. The new steel is first carburized within the temperature range of 1650 to 1800 F, followed by air or liquid quenching. It is then repeatedly heated to a temperature within the range of 600 to 1200 F and cooled to

Bower 315 *tubing sections from which bearing races are machined.*

COMPOSITION OF BOWER 315, %

Carbon	0.10-0.15
Manganese	0.40-0.60
Phosphorus	0.025 max
Sulfur	0.025 max
Silicon	0.20-0.35
Nickel	2.60-3.0
Chromium	1.35-1.75
Molybdenum	4.80-5.20
Iron	Bal



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to finished product

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Saint Louis, Missouri

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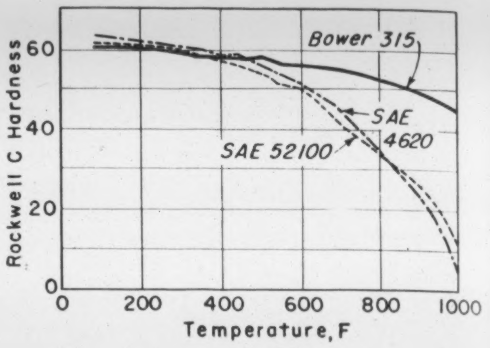


***Hot hardness** of Bower 315 compared with that of two standard SAE grades.*

approximately room temperature. This converts the austenite to martensite a portion at a time, thus preventing excessive hardness, stress and size changes. As a result, the surface of the steel possesses high hardness and resistance to wear at high operating temperatures.

Other characteristics of the new material include:

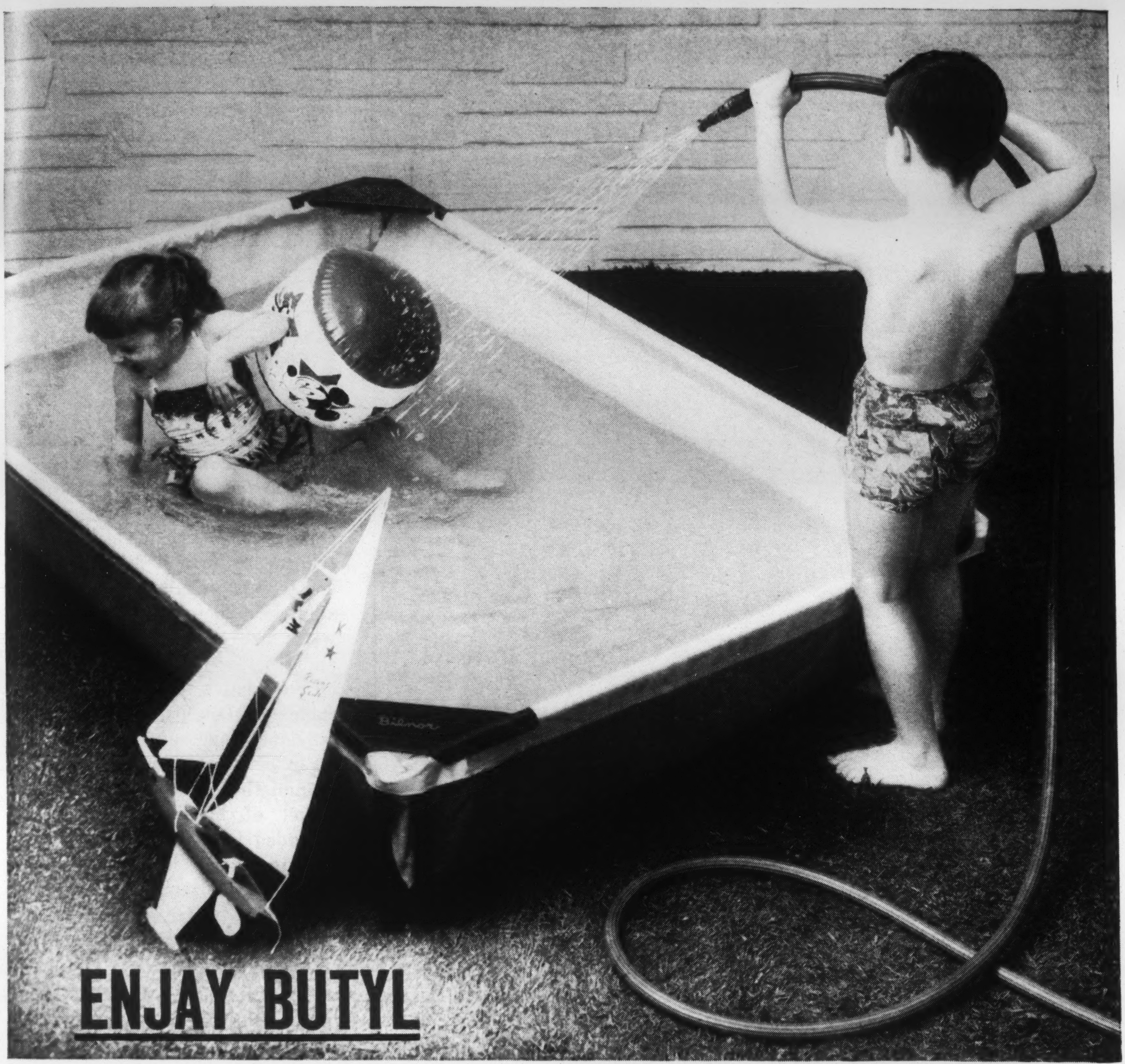
1. The coefficient of thermal expansion is close to that of steels used for shafts and housings. This prevents difficulties that could be caused by the difference in dimensional changes over the wide range of operating temperatures.

2. The material is readily machined. Case hardening after machining gives the bearing surface a hardness of 58-60 Rockwell C, with good wear resistance.

3. On test stands, bearings made of the new alloy have operated without failure at temperatures up to 600 F. Tests include acceleration of the shaft from rest to 11,000 rpm in as little as 8 sec.

Polyethylene Insulation for Telephone Cables

Polyethylene insulation has helped to make possible the laying of the 1600-mile Alaskan telephone cable from the State of Washington to Alaska and the laying of the North Atlantic telephone cable from the United States to Great Britain. In making these polyethylene insulated



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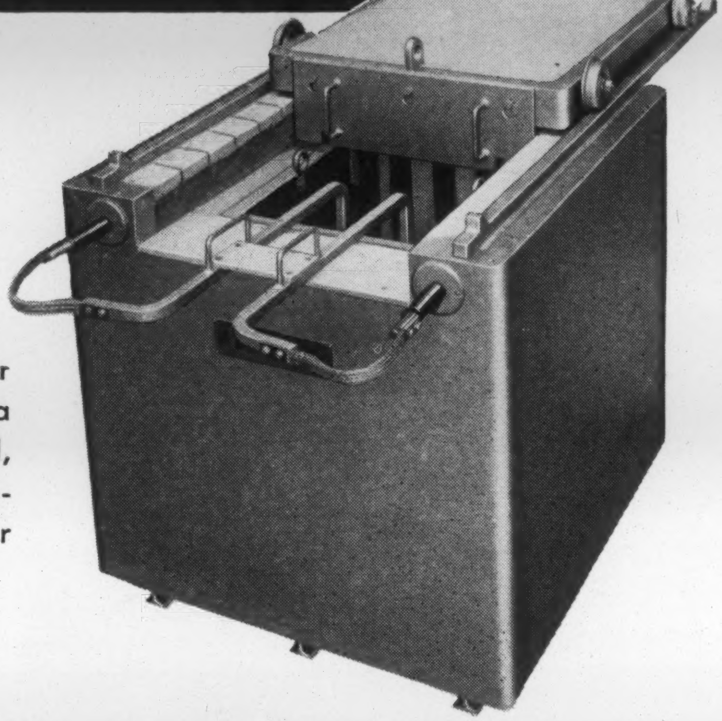
WITH IMMERSED ELECTRODES

Temperatures
from
300° F.
to
2400° F.

Built to any size or capacity with either a ceramic, welded steel, or alloy pot whichever the particular process requires.



SPECIAL FEATURES
of the HEVI-DUTY FURNACES

- Immersed alloy electrodes with water-cooled terminals which prevents the conduction of heat to the transformer.
- Self-contained ceramic pot quickly removable. Ceramic, steel, or alloy pots are interchangeable—thus one furnace can be used for a variety of operations by merely changing to the pot best suited for the process.
- Electric starting coil quickly remelts the salt after a shut-down.
- Recessed electrodes permit a rolling cover, thus minimizing heat radiation from the bath surface.
- Low operating voltage eliminates shock danger.

Send for Bulletin 655. It describes the other advantages of Hevi-Duty Salt Bath Furnaces.

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Dry Type Transformers Constant Current Regulators

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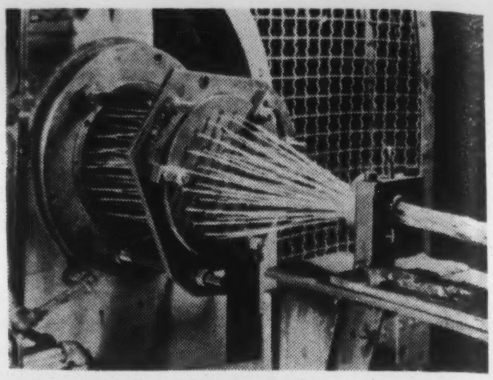


Insulated conductors *are twisted together to make a cable core.*

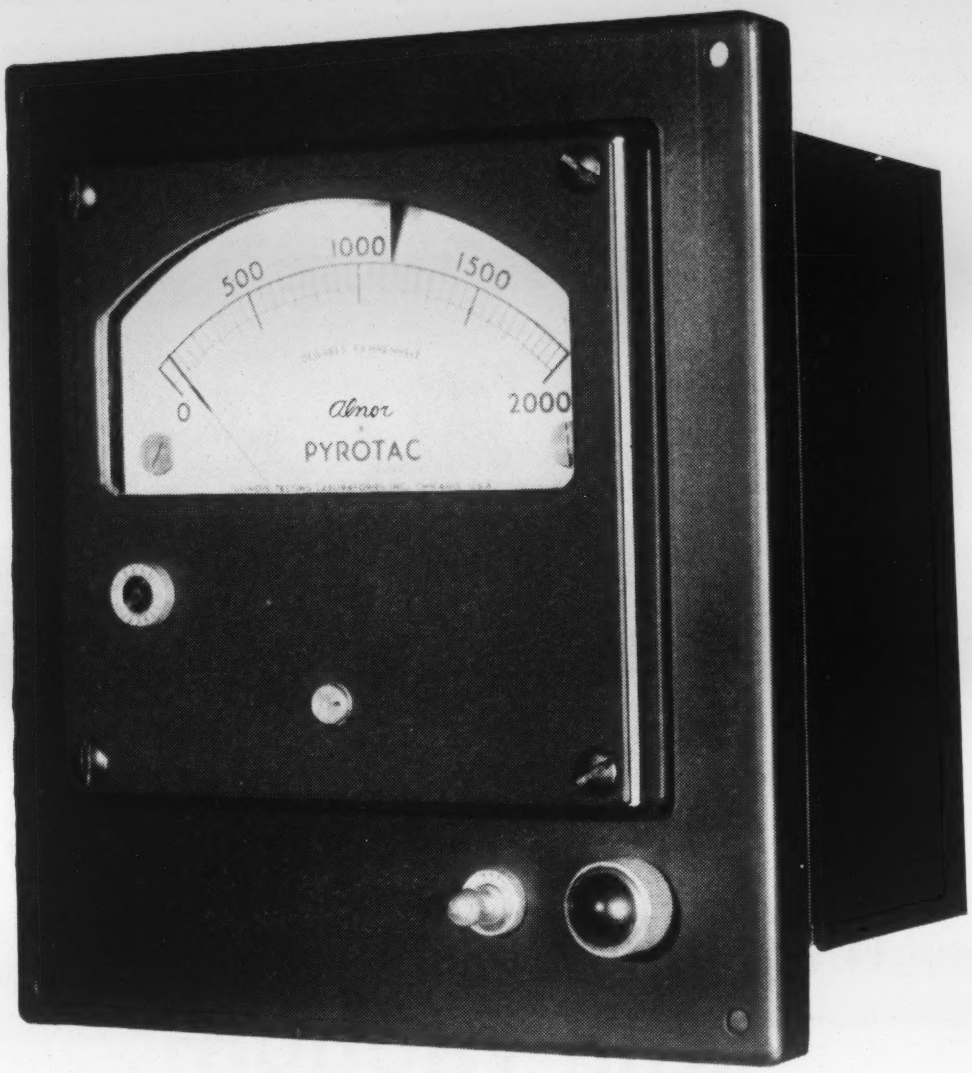
cables, polyethylene is first extruded to form a 1/64-in. thick continuous insulation around a single conductor. Pairs of these wires are then twisted together and fed through a die that twists 50 wire pairs together to form a cable core (see photo). Then polyethylene tape and a shielding layer of aluminum are wrapped around the core before the outer jacket of black polyethylene is extruded in place. The polyethylene insulation is said to weigh about half as much as lead-paper insulation, which was formerly used as an insulation on telephone cables.

Use of polyethylene as telephone cable insulation is said to eliminate fadeout and atmospheric disturbances, thus providing local call clarity. Other advantages claimed for polyethylene insulation in this application are its low rate of water absorption, its chemical stability in corrosive sea water and its flexibility.

Zippered Tubing Speeds Wire Tying

A zipper style vinyl plastics tubing, called Zippertubing, has been introduced by W. A. Plummer Mfg. Co., 752 S. San Pedro St., Los Angeles. Approved under Air Force specifications, the tubing is designed for use as a protective covering for electrical wiring in aircraft and electronic assemblies. It contains a zipper

PYROTAC



Automatic protection against temperature damage

Just as a fuse protects electrical circuits against overloads, the Alnor Pyrotac automatically protects furnaces, kilns and other heating equipment against damage due to excessive temperatures.

This low-cost, easily installed instrument can be added to any automatic or manually controlled equipment and give continuous protection...safeguard your investment in equipment, controls and material in process.

Highest Alnor quality throughout, the Pyrotac features Alnico magnet, double air-gap movement that is standard in all Alnor pyrometers...laboratory precision...industrial ruggedness which assures top reliability.

Write today for complete details on the Pyrotac, available in eight scale ranges from 0-600° F. and 0-3000° F. Ask for Bulletin 2002. Illinois Testing Laboratories, Inc., Room 522, 420 North LaSalle St., Chicago 10, Illinois.

Alnor

ALNOR PRECISION INSTRUMENTS
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Plated under vacuum, these articles have a high-sheen surface that lasts as long as conventionally plated pieces.

Why plating
with vacuum
is easier and more profitable

Without buffing or polishing, without corrosive cleaning baths, without highly skilled help, you can now cover articles like those shown above with a shimmering finish that lasts for years.

All it takes is a CEC vacuum coater and some inexpensive lacquers to make metal and plastic articles look silver, gold, copper, or a multitude of other colors and tones.

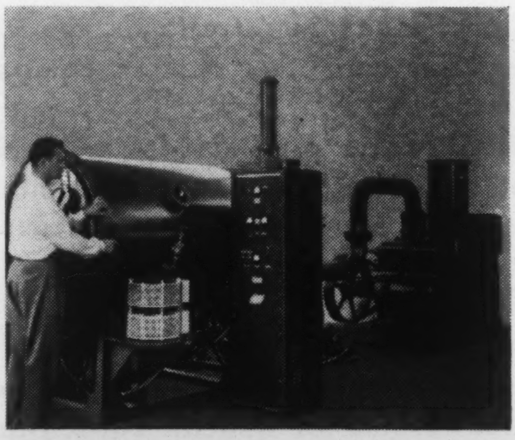
Vacuum-plating costs less. With a CEC vacuum coater you can plate thousands of pieces per day with unskilled labor.

New longer-lasting lacquers. There are on the market many lacquers which can make vacuum-plated articles wear as well as those plated in conventional ways.

The stayfast finish requires no retouching, or buffing, or polishing—just an easily applied coat of lacquer.

You can control film thickness easily and precisely. You can make surfaces electrically conductive *or* insulating as you wish.

For further information on this highly profitable process, write for information on the coaters, the lacquers, and the methods used.



1450 2½" diameter pieces per cycle, 3 to 6 cycles an hour—that's the production rate of this 48" CEC vacuum coater.

Consolidated Electrodynamics
Rochester Division, Rochester 3, N. Y.
formerly Consolidated Vacuum

OFFICES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

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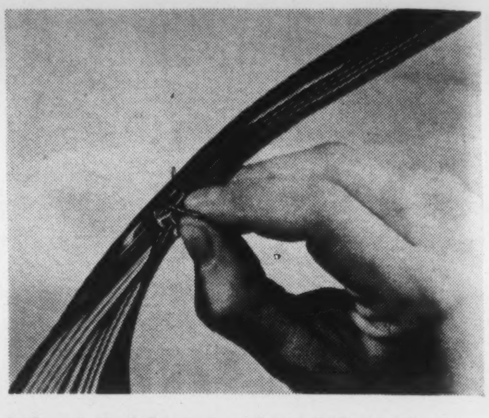

Vinyl tubing *is zipped together.*

that is used to open or close the tubing for easy removal of the wiring. It may be "unzipped" and reused or permanently sealed with a sealer; when sealed the tubing is said to withstand a linear strength test of 30 psi. It is used primarily for lacing and tying wiring ducts; as a wire marking; and as a replaceable cable jacket to protect expensive custom cables from abrasion.

It is available in nine colors, in lengths from 20 to 1000 ft, and in wall thicknesses of 0.020 to 0.040 in; inside diameters of the tubing range from ½ to 4½ in.

Two New Finishes for Magnesium Parts

Development of two new finishes for all forms and alloys of magnesium has been announced by Turco Products Inc., 6135 South Central Ave., Los Angeles 1, Calif. The finishes may be applied to magnesium parts without the use of complicated control procedures or precise measuring and mixing of several chemicals. Called Turcoat 4245-2F and Turcoat 4091, the finishes are said to provide corrosion resistance, paint-base qualities and abrasion resistance.

Turcoat 4245-2F is designed for production line use and may be applied by either d.c. or a.c. Two types of finishes are obtained with the use of Turcoat 4245-2 F: low voltage produces a thin, flexible, light green film on magnesium

FREE *new* BOOKLET *tells how to get* BETTER PAINT ADHESION

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If other booklets described below are also desired, please enter numbers corresponding to booklets wanted ______________________

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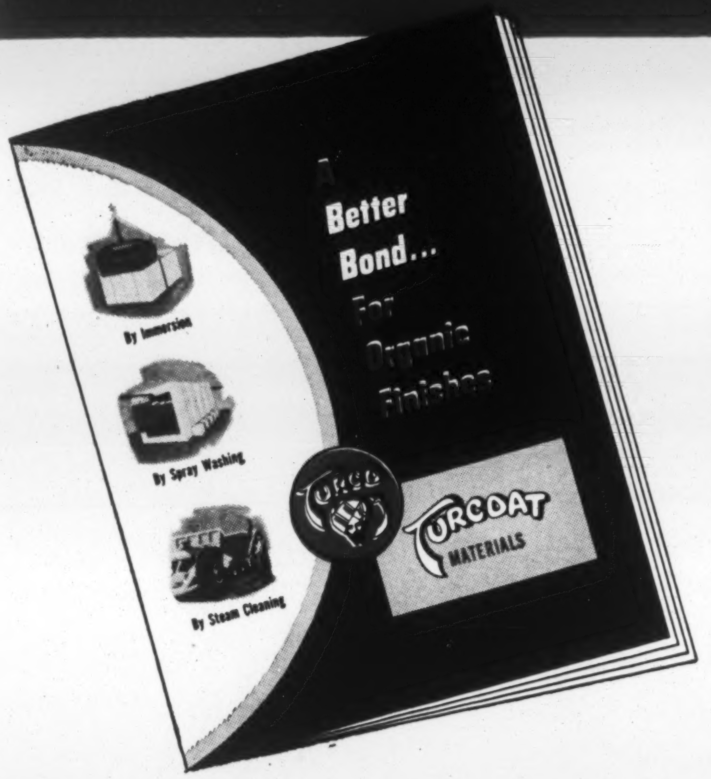

Complete *PHOSPHATING* Reference Chart includes:

- Description of phosphating
- Diagram of how phosphating holds paint to metal
- Illustrations of what phosphating can do
- Types of coatings available
- Recommended uses
- Applicable Government Specifications
- Methods of application and equipment requirements
- Metals to be used on
- Coating weights
- Detailed operation cycles

Here...in the free Turcoat phosphating booklet...is the best solution to any paint adhesion problem. This new booklet describes the *complete* line of Turcoat materials—the coating compounds that assure *permanent* paint adhesion, slash rejects, require less complicated controls and are more economical to buy and use.

Only Turco offers a truly full line of government approved coating materials for use in *any* conceivable processing set-up prior to the use of organic finishes. Only Turco offers a staff of 160 technically trained representatives located in all parts of the country to give immediate 'round-the-clock service. No wonder Turco is adding new phosphating accounts at a phenomenal rate. There are many reasons why, when it comes to *paint adhesion,* more and more industrial concerns are turning to the Turcoat line. The Turcoat booklet lists them all.

BOOKLETS ALSO AVAILABLE ON:

1. Titanium Descaling
2. Stainless Steel Descaling
3. Magnesium Finishing
4. Hot Tank Cleaning
5. Dye Penetrant Inspections
6. Alkaline Rust Removing
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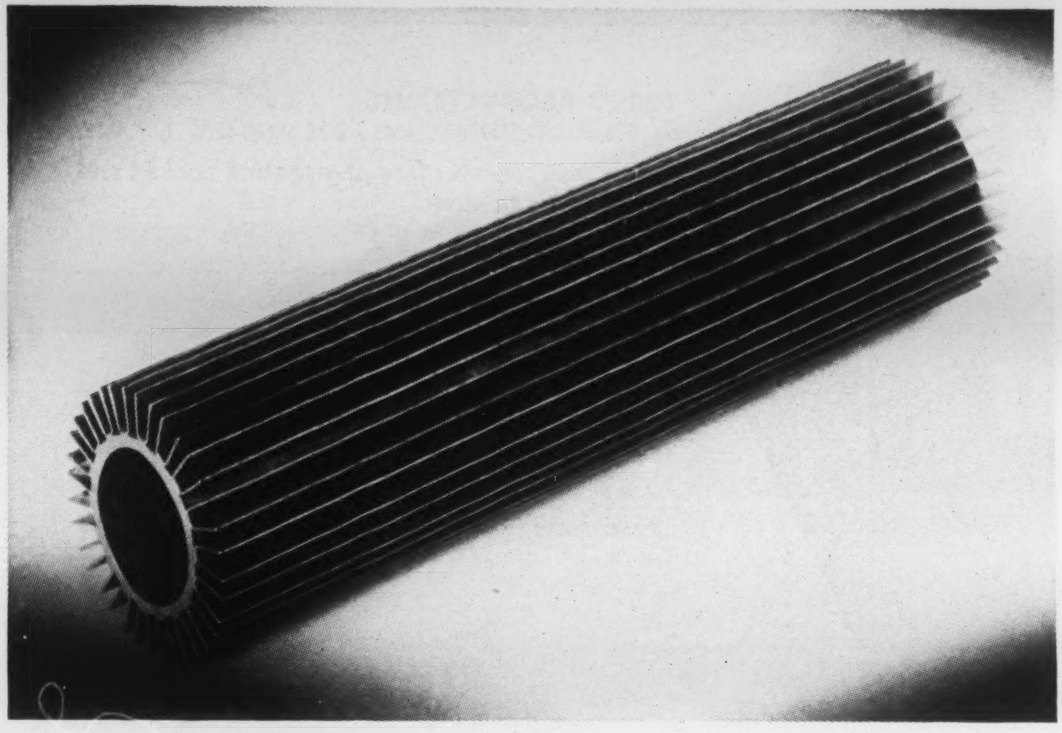
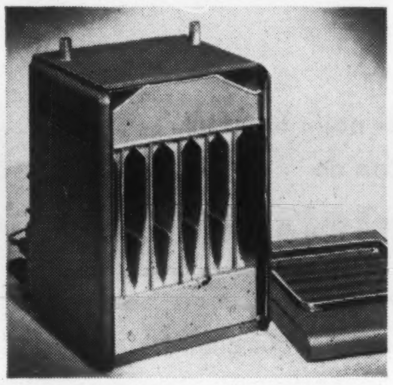
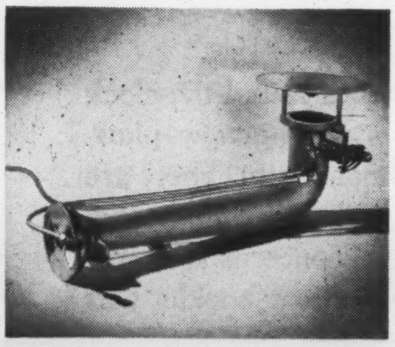


Heat exchanger used in evaporators and condensers will withstand 1600° F indefinitely.



Stainless Alloy Surface protects heat exchanger element in gas-fired unit heater which operates at approximately 1600° F.



Stainless Alloy Surfaced flame spreader replaces Stainless Steel spreader normally used in fuel burner nozzle at a 40% cost saving.

Heat treatment retorts operating up to 2600° F can be protected against heavy oxidation which reduces service life.

Heat Protection

Up to 2600° F.

Steels having a carbon content from 1008 to 1053 can now be given a *Stainless Alloy Surface* providing heat resistance equal to that afforded by Stainless Steels. A new, low-cost process — ASC Metal Diffusion — creates by atom interchange a chromium-rich surface that gives unlimited heat protection at 1600° F. and limited protection up to 2600° F.

Unlike coatings, platings and claddings, an ASC Stainless Alloy Surface becomes an integral part of the processed work. It will not chip, peel, craze or crack. The Process is applicable to all iron, steel, and ferrous alloys — and forming, welding, brazing and soldering, can be done by methods in general use.

ASC Metal Diffusion also gives low and medium carbon ferrous products *corrosion* resistance equal to that of 430 stainless. Medium and high carbon content products can be given *wear* resistance surface hardness of RC 70-72. For more information about this revolutionary process write for data, consultation, or product demonstration.

ALLOY
SURFACES
COMPANY
103 South Justison St., Wilmington 1, Del.

For more information, turn to Reader Service Card, Circle No. 375

sheet products; and high voltage produces a thick, dark green film with more corrosion and abrasion resistance.

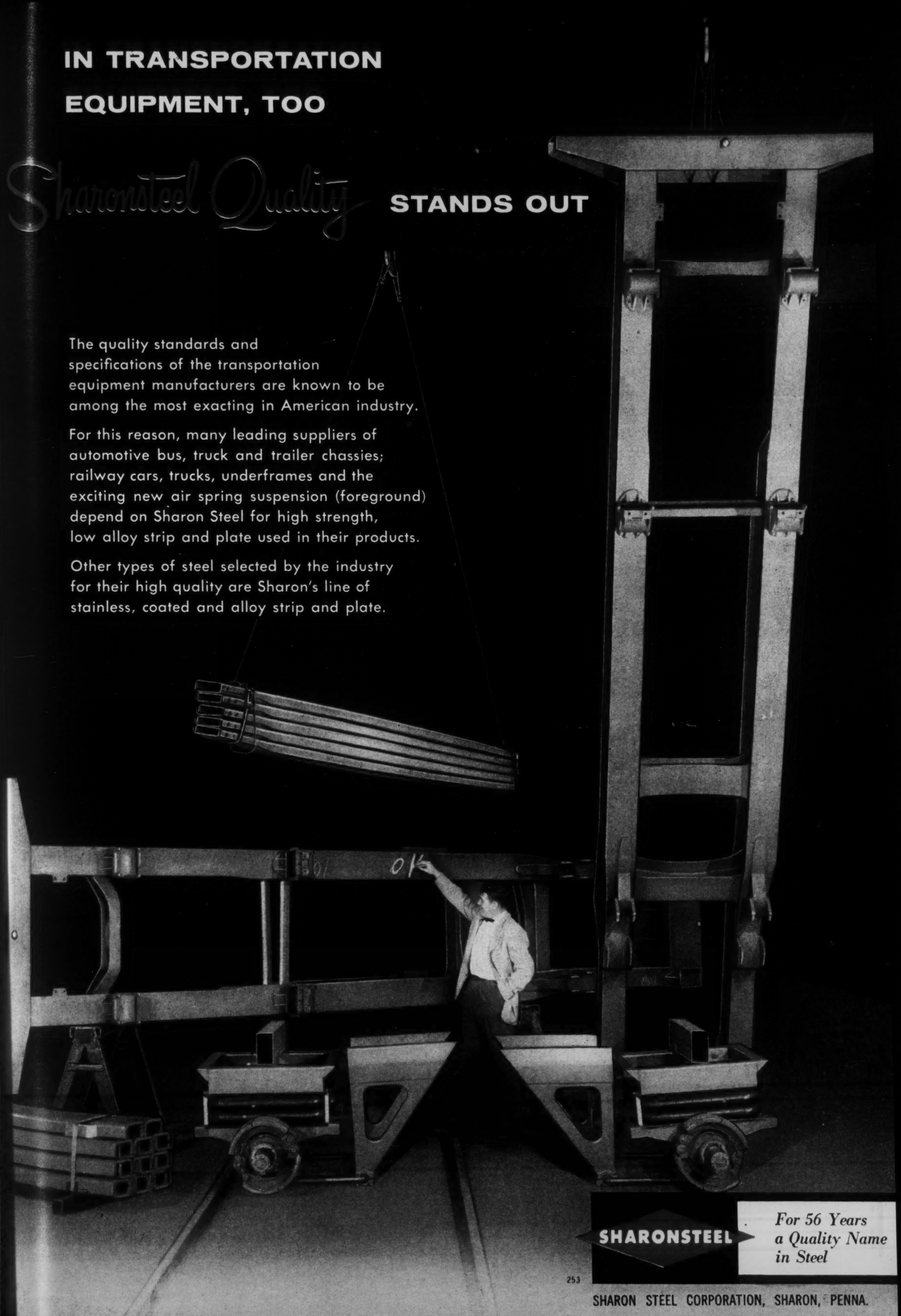
Turcoat 4091 is a finish used for touching up previously coated magnesium parts that have been scratched in production. It may be used also as a finish on magnesium parts that are too large for production line use.

Use of Urethane Foams as Seating Materials

One of the largest single potential markets for urethane foams is automotive seating. At present, however, these materials are not being used to any great extent in this field—due in part to disappointing test results obtained on an earlier type of polyester foam. Originally, only one general type of urethane foam was commercially available. Today the formulations of foams and the techniques for applying them have been improved to such an extent that large-scale production of different types of seating units with specific physical properties is possible. Data given in a paper presented by R. H. Walsh, of E. I. du Pont de Nemours & Co., at the SAE National Passenger Car, Body and Materials meeting, held earlier this year in Detroit, indicate that all of the deficiencies of the earlier type of foam for this application can be overcome by using the proper type of resin and compound, plus up-to-date manufacturing techniques.

In evaluating a seating material, comfort under use conditions is the fundamental specification that is used to judge a foam's acceptability. A number of standard physical tests are used to correlate actual physical property data with performance characteristics of a foam seating material. The tests include compression de-

For more information, Circle No. 378 ➤


IN TRANSPORTATION EQUIPMENT, TOO

Sharonsteel Quality STANDS OUT

The quality standards and specifications of the transportation equipment manufacturers are known to be among the most exacting in American industry.

For this reason, many leading suppliers of automotive bus, truck and trailer chassies; railway cars, trucks, underframes and the exciting new air spring suspension (foreground) depend on Sharon Steel for high strength, low alloy strip and plate used in their products.

Other types of steel selected by the industry for their high quality are Sharon's line of stainless, coated and alloy strip and plate.

SHARONSTEEL

For 56 Years a Quality Name in Steel

253

SHARON STEEL CORPORATION, SHARON, PENNA.

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flection, hysteresis, strain decay, resilience and flex fatigue tests. In describing recent technical advances in urethane foams, Mr. Walsh compares the physical properties of urethane foams with those of natural rubber foam. The results of his findings are listed below.

Compression set — Compared with natural rubber foams, urethane foams have an initially high modulus that is translated into a crisp, harsh feel to the rider. It is possible, however, to change the load deflection curve of urethane foam by at least three means:

1. The type or chemical composition of the starting polyol can be changed; for instance, a polyether resin can be substituted for a polyester resin as the starting polyol.

2. The foam can be compounded with modifying additives; for example, small amounts of an elastomer can be added to the foaming composition, preferably in the form of a latex, to raise the compression deflection curve of the material.

3. The foam can be cut and shaped mechanically to modify its properties.

Chemical, compounding and mechanical techniques are available for modifying urethane foams to give almost any desired form of load-deflection curve.

Hysteresis — Urethane foams with a slow recovery rate usually have a high hysteresis or energy loss, which causes the upholstery fabric to fold and lay in a baggy fashion across the indented area where the foam does not bounce back to its original height. Improved urethane foams made from polyethers have hysteresis properties comparable to those of natural rubber foams and perform well in use tests. Improved foams made from compounded polyester resins also have good hysteresis properties.

Strain decay—A strain decay

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  A full line of cleaners and etching compounds especially formulated for use on aluminum alloys prior to plating, anodizing, painting or welding.
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  An especially effective zincate bath for preparing aluminum for plating.
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  An effective cleaner for fabricated aluminum parts before finishing.
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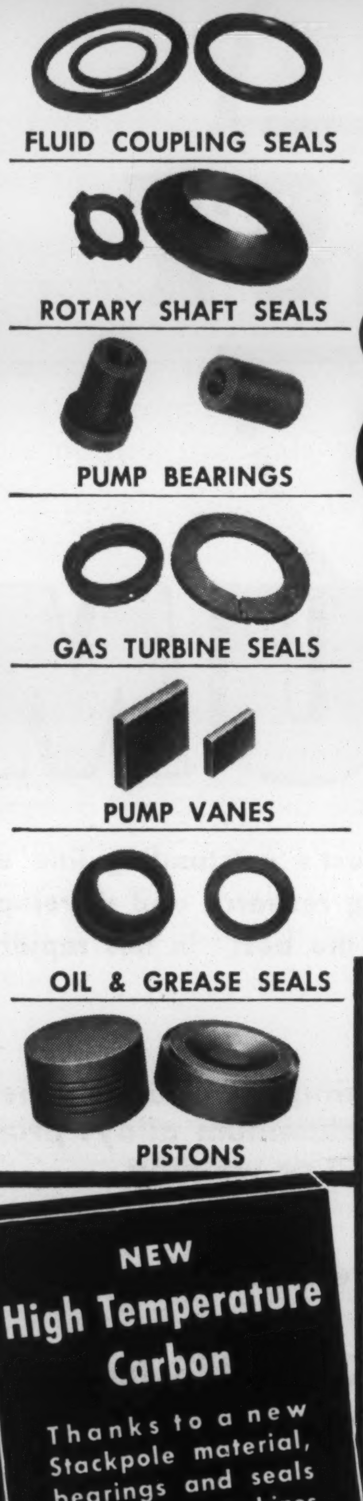

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Stackpole carbon and graphite—used singly, in combination, or mixed with metal powders—bring design flexibility to hundreds of mechanical engineering problems.

Special grades are constantly being developed to meet specific requirements.

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CARBON GRADES FOR MECHANICAL APPLICATIONS

Grade	Hardness	Strength	Apparent Density	Max. Safe Oper. Temp. ° F	Typical Applications
SK 16	45	6000	1.75	250	Water Pumps
SK 182	70	8000	1.77	350	
SK 180	80	7000	1.75	650	Corrosive Chemicals
469	80	8000	1.80	1200	High speed, High Temperature Aircraft
SK 145	90	8000	1.80	800	
SK 187	80	9000	1.79	650	High Altitude Bearings
SK 188	65	7000	1.78	650	
SK 152	100	10000	1.75	650	Very hard material for bearings operating in liquid
SK 154	100	10000	1.75	650	
SK 157	75	7000	1.80	250	Appliance Seals
SK 176	80	7000	1.80	650	
SK 105	75	7000	1.60	500	Oil Seals
SK 175	75	7000	1.75	500	
304	80	9000	1.79	650	Vanes & Bearings
331	50	7000	1.74	800	Turbine Rings
P87	70	6000	1.68	650	
Y20	40	3000	1.65	650	
SK 21	45	7000	2.70	250	
SK 87	70	7000	1.77	250	
SK 201	50	7000	1.79	800	
378	65	8000	1.78	650	
G560	45	4500	1.68	800	
HB1	35	3000	1.58	800	
HB1-4	30	4000	1.68	800	

NEW
High Temperature Carbon

Thanks to a new Stackpole material, bearings and seals used in gas turbines and other high temperature applications show minimum oxidation at temperatures up to 1200°F compared to the usual limit of 800°F for non-treated materials.

STACKPOLE

STACKPOLE CARBON COMPANY, *St. Marys, Pa.*

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phenomenon, common with urethane foams, causes the seat user to have a feeling of continually sinking into the cushion during use. Foams made from compounded polyethers and polyester resins show less tendency to undergo strain decay than uncompounded urethane foams, and have properties similar to those of natural rubber foam.

Resilience—The resilience properties of both polyester and polyether urethane foams, though lower than those of natural rubber foams, can be increased substantially by compounding techniques. Tests have shown that cushions with low resilience have less tendency to sway and the low resilience properties of urethane foams may help solve this problem of transportation seating.

Flex life—Urethane foams vary, as do natural rubber foams, in their resistance to flexing. Compression changes for properly cured urethane foams range between 10 and 35%, using the same compression test. Two main factors seem to influence the performance of a urethane foam in flex tests. The first is the amount of tack developed between the cell walls during flexing, and the second is the state of cure of the foam. Tack can be minimized by the use of an ester plasticizer and by the proper choice of surfactants for the foaming composition. A full cure is obtained in urethane foams when all of the isocyanate, water and resin have reacted.

Aging—The best upholstery material must age satisfactorily or it is of no practical use. In several cases polyester foams have failed to give satisfactory performance, becoming soft in only a few months of service. These are isolated cases and are not typical of the class. However, these experiences have shown the need for care in preparing urethane foams. Hydrolysis of the

Attention! All Users of Nickel Alloys...

New Driver-Harris Vacuum Melting Service Now in Operation

After many years of experience with vacuum melting programs, Driver-Harris now offers a complete vacuum melting service for almost all of the 132 special purpose alloys made by this company.

The specific benefits gained by vacuum melting in the production of nickel-chrome alloys are today clearly established. They are:

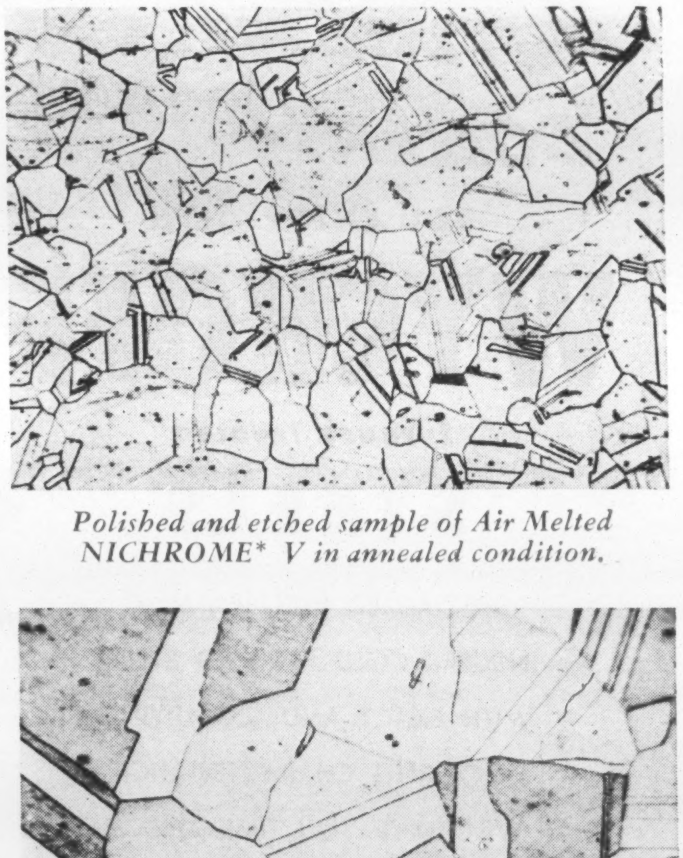
1. Much closer control of analysis—particularly in alloying with the highly reactive elements, Titanium, Aluminum, Columbium, Calcium, and Zirconium. The normally high affinity for nitrogen and oxygen these elements have is completely eliminated in vacuum melting, thereby opening new avenues in alloy production.

2. Great reduction in inclusions, especially oxides and nitrides, results in higher ductility and tensile properties. In fine wires, the improvement in properties is frequently so great that wire sizes may be reduced without sacrifice of strength. An example of the greatly improved microstructure is illustrated in the metallographs shown.

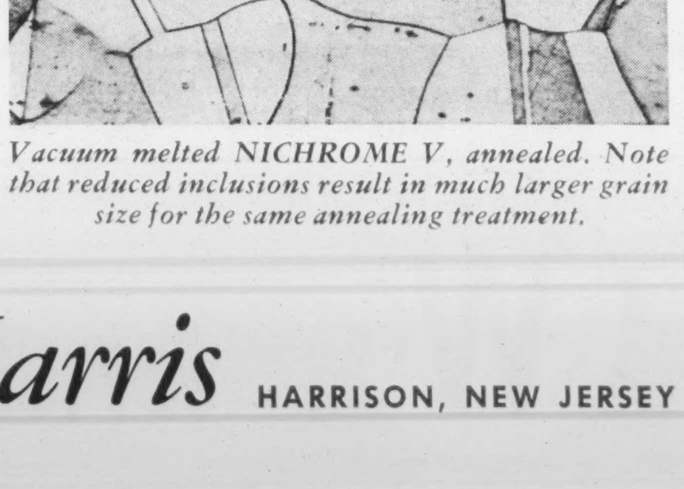
3. Complete elimination of gas, not from the surface only but from the entire mass. Alloys so produced are therefore more desirable in the manufacture of electron tubes.

4. General improvement in electronic, electrical, and mechanical properties to meet specifications. Because closer control of analysis is a primary advantage of vacuum melting, we can now achieve these specific improvements with remarkable certainty.

Almost all of the Driver-Harris Alloys now vacuum melted and processed under close physical and analytical control show improvement in one or more of the above ways. If you are seeking further improvements in the D-H Alloys you use, inquire now for information on how Driver-Harris Vacuum Melting Service can help you. Address your inquiry to Dept. VMS.



Polished and etched sample of Air Melted NICHROME V in annealed condition.*



Vacuum melted NICHROME V, annealed. Note that reduced inclusions result in much larger grain size for the same annealing treatment.

*T. M. Reg. U. S. Pat. Off.

Driver-Harris COMPANY HARRISON, NEW JERSEY

BRANCHES: Chicago, Detroit, Cleveland, Louisville, Los Angeles, San Francisco In Canada: The B. GREENING WIRE COMPANY, Ltd., Hamilton, Ontario

MAKERS OF THE MOST COMPLETE LINE OF ALLOYS FOR THE ELECTRICAL, ELECTRONIC, AND HEAT-TREATING INDUSTRIES

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urethane and urea links in the polymer cause poor aging of the foam. Urethane foams with good aging properties can be made from present polyester resins by close control of the reactants during foaming and by using hydrophobic polyols. On the basis of accelerated tests it is believed that urethane foams should perform well for at least 15 or 20 years of normal use.

Elevated temperature properties — Both polyester and polyether urethane foams perform well at temperatures as high as 240 F. The normal operating conditions for seating foams usually do not involve temperatures exceeding 240 F.

Mr. Walsh finds that with new compounding techniques potential applications for urethane foams in tomorrow's car should exceed 24 lb. These applications include molded seat units, headliners, foam-backed upholstery for sidewalls, door and trunk liners, crash protecting devices for the rear seat rider, rug underlays, and rigid foams for sound and heat insulation on the firewall and under the hood.

Ionitriding Gives Steel Hardest Surface Yet

A new steel nitriding process, claimed to give steel parts a surface hardness greater than previously possible, utilizes a high current electrical discharge to convert electrical energy into heat.

Developed by Bernard Berghaus in cooperation with the Northrhine-Westphalia government, the so-called ionitriding process is the result of many years' research with high current glow discharge. The following example of the technique as applied to steel tubes will serve as an effective illustration:

Steel tubes are inserted in a hydrogen-nitrogen atmosphere. A

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the TIME and DOLLAR SAVINGS
YOU ENJOY WITH
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STEELS
SPECIALIZED PRE-TREATMENT INSURES COLD FINISHED STEELS WITH EXACT AND UNVARYING WORKING CHARACTERISTICS THAT WILL SAVE YOU TIME AND MONEY ON YOUR OPERATIONS
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The Felts of the Future that are here today!

Eliminate virtually all problems encountered with conventional materials in 3 major reinforced plastic fields and are ideal for filtration, high temperature bearing seals, gasketing. The new FEUTRON mechanically interlocked felts, recently developed by American Felt Company, are of 100% synthetic fiber construction. Although particularly suited to the reinforced plastic (low pressure) field their uses are practically unlimited.

The three reinforced plastic fields in which FEUTRON felts are especially suited: electrical and electronic equipment, as overlays in fiberglas mat reinforced bodies, where chemical or corrosion resistance is necessary.

FEUTRON FACTS

1. **Exceptional chemical resistance with thermal stability to 300F.**
2. **Non-hygroscopic and biologically stable.**
3. **Produces a smooth, fiber-free surface in finished product.**
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10. **Excellent dielectrical properties.**

FEUTRON FELTS are available in DACRON** . . . ACRILAN*** . . . ORLON† . . . DYNEL†† . . . NYLON . . . ARNEL††† . . . VINYON‡ . . . VICARA‡‡

Investigate FEUTRON felts further, by sending for Technical Bulletin, making request on your firm's letterhead. *Registered trademark

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***Acrylic fiber by Chemstrand
†DuPont trademark for its acrylic fiber
††Union Carbide's acrylic fiber
†††Celanese Corp. trademark for its tri-acetate fiber
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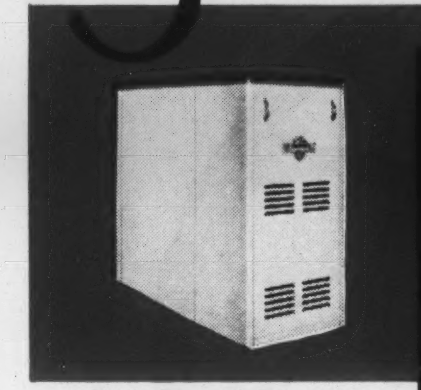

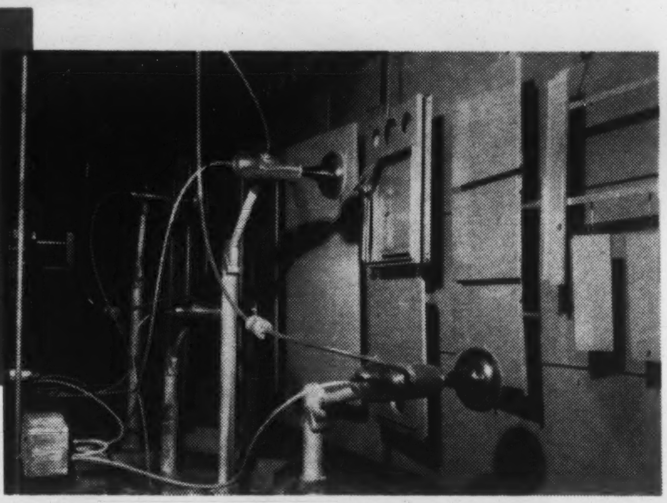

3 times as many Furnace Casings per gallon of paint with **RANSBURG NO. 2 PROCESS!**

This Lo Boy model, Series 6000, is typical of the Waterman-Waterbury line of winter air conditioners now painted electrostatically.

Quality of work is improved; Labor costs are cut and Production Stepped up 150% with

RANSBURG Electrostatic Spray Painting

Results exceeded expectations when Waterman-Waterbury, Minneapolis, modernized their finishing department and went from hand spray to Ransburg No. 2 Process in painting their quality line of heating and air conditioning equipment.

By the former hand spray method, W-W used a half gallon of paint to coat a single casing. Now, with Ransburg No. 2, they get SIX CASINGS PER GALLON . . . or 3 times as many per gallon. Furnace casings, as well as other painted parts which go into the famous Waterbury Furnaces, now get a uniform coating of .8-mil.

Production was increased, too, as automatic painting enabled them to step up the conveyor speed from 7 fpm to 11½ fpm. Where they formerly turned out a complete furnace in five minutes, NOW they assemble three in just six minutes . . . an increase of 150%. All in all, they figure the modernization program—with Electro-Coating—saved over $11,000 in the first three months of operation.

NO REASON WHY YOU CAN'T DO IT TOO!

Whatever you paint, we'd like to tell you more about the efficiencies and worthwhile savings which can be yours with Ransburg Electro-Coating Processes. Get our No. 2 Process brochure which cites many on-the-job examples of electrostatic spray painting on a wide variety of products. Or, we'll be happy to loan you our new film, "The Big Attraction" which tells the electrostatic spray painting story in sound and full color.

Call or write

RANSBURG
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Barth and Sanders, Indianapolis 7, Indiana

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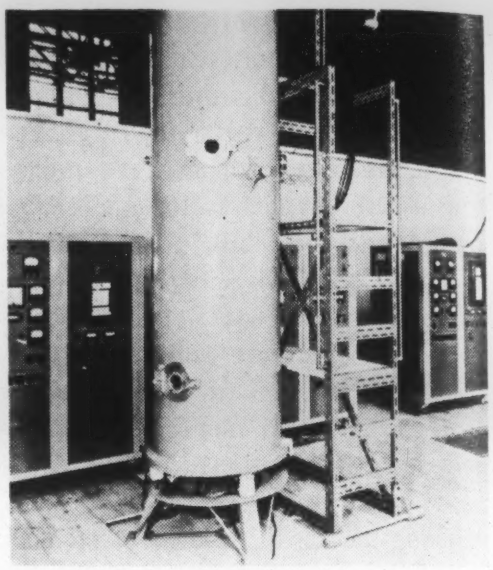


***Electrical discharge** equipment used in ionitriding.*

bluish discharge, induced at the electrically isolated tubes, causes the tubes to be heated to a temperature of over 1032 F. As a result the nitrogen diffuses and hardens the surface. Although a charge of more than 35 kw is applied, it is claimed that even precision tubes, ground to final dimensions before ionitriding, will not distort during the process.

The hardening of the steel tubes is done almost automatically and with very little consumption of gas. Apart from the process of inserting and extracting the tubes, practically no supervision is required for the duration of the process—approximately 40-50 hr.

The ionitriding process is especially suited to parts with long, narrow or complicated bores; to parts with internal sections that require an even inside hardening and an even flow of hardness; to parts with pocket bores or narrow slots; and to parts with very close tolerances.

Silicone Compounds Have Low Shrinkage

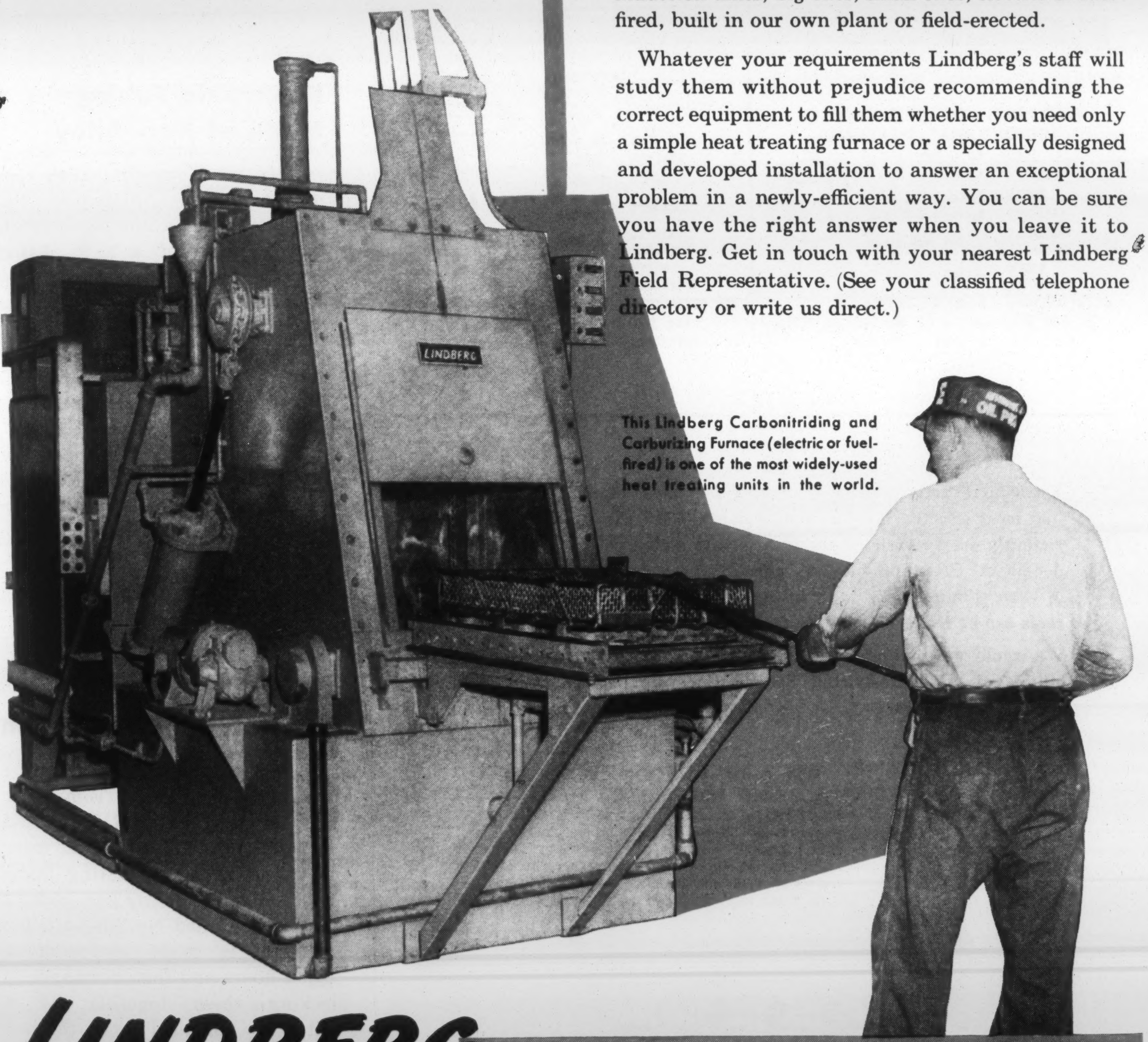
Molded products and o-rings are being produced by Parker Appliance Co., 17325 Euclid Ave., Cleveland 12, Ohio, in three new low shrink silicone rubber compounds. The compounds, No. 76-

THE ONE BEST WAY TO SELECT HEAT TREATING EQUIPMENT

Talk it over with the most experienced furnace experts you can find

That is exactly what we can offer you at Lindberg. A design and engineering staff concerned only with the development of equipment for applying heat to industry. This staff produces the most complete line of such equipment in the industry—heat treating furnaces, melting furnaces, ceramic kilns, high frequency induction units; big ones, small ones, electric or fuel-fired, built in our own plant or field-erected.

Whatever your requirements Lindberg's staff will study them without prejudice recommending the correct equipment to fill them whether you need only a simple heat treating furnace or a specially designed and developed installation to answer an exceptional problem in a newly-efficient way. You can be sure you have the right answer when you leave it to Lindberg. Get in touch with your nearest Lindberg Field Representative. (See your classified telephone directory or write us direct.)



This Lindberg Carbonitriding and Carburizing Furnace (electric or fuel-fired) is one of the most widely-used heat treating units in the world.

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for Spring Steel Requirements such as these . . .

FORMED PARTS FOR HEAT TREATMENT

SIZE	8 x .036
ANALYSIS	1050
FINISH	Bright
HARDNESS	Rockwell B-78 Max.
THICKNESS TOLERANCE	±.0003 incl. crown
WIDTH TOLERANCE	±.005
MICROSTRUCTURE	Uniform spheroids
COIL SIZE	16" I.D. coils large as possible
PACKAGING	On skids — shrouded

FLAT PARTS FOR HIGH STRENGTH WITHOUT HEAT TREATMENT

SIZE	10 x .020
ANALYSIS	1075
FINISH	Bright
HARDNESS	Rockwell C-30 Min.
THICKNESS TOLERANCE	±.001 incl. crown
WIDTH TOLERANCE	±.005
MICROSTRUCTURE	Small-fine carbides
COIL SIZE	16" — I.D. Max. coil wt. 1000#
PACKAGING	On skids — shrouded

SIZE	14 x .040
ANALYSIS	1095
FINISH	Bright
HARDNESS	95 to 105 Rockwell B suitable for blanking
THICKNESS TOLERANCE	±.0005 incl. crown
WIDTH TOLERANCE	±.005
MICROSTRUCTURE	Uniform medium size spheroids
COIL SIZE	16" — I.D. Max. coil wt. 600#
PACKAGING	On skids — shrouded

Knowing exactly what you require for most efficient fabrication and most effective product performance, CMP can set up and consistently meet restricted specifications to match your most exacting demands. Often production operations can be greatly simplified or even eliminated; in most instances end-product and/or assembly costs can be reduced and quite frequently, product quality improved.

We would welcome an opportunity to explore with you the possibilities of CMP Restricted Specifications applied to your strip steel requirements.

FOR 3 IN 1 SERVICE ON YOUR COLD ROLLED STRIP STEEL

Now there are three CMP plants with facilities for production of "Restricted Specification" cold rolled strip. Strategic locations at Youngstown, Indianapolis and Los Angeles, provide the security of 3 sources of supply plus the close working relationship which these local production centers make possible.

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PLANTS: YOUNGSTOWN, INDIANAPOLIS AND LOS ANGELES
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128, 77-248 and 78-138, have 60, 70 and 80 Shore A durometer hardnesses, respectively, and meet AMS 3303, 3304 and 3305 specifications. According to the company, the low shrink properties of these reddish brown silicone compounds permit their use in molds that are used for organic rubber compounds, eliminating special tooling, time delays for tool construction, and high rejection rates.

Electronic Tubing Made of New Alloy

Superior Tube Co., 1548 Germantown Ave., Norristown, Pa., has introduced a line of electronic tubing made of a new passive cathode material that is said to be approximately twice as strong as other passive alloys at operating temperatures. Designated Cathaloy P-51, the alloy contains 4% tungsten, and its yield strength is approximately 5000 psi at 1400 F.

The alloy was developed for electronic tubes that must operate under conditions of barium evolution, shock and vibration. Supplied to customers' specifications, it is especially useful in ruggedized tubes.

Crimped Nylon Fabric for Hot, Cold Insulation

A self-supporting nylon batting material, available from Star Woolen Co., Cohoes, N. Y., is said to have characteristics that make it useful as an insulating material and as a padding and packing material. Called Ny-Sul-Loft, the material is made by crimping nylon fibers and then permanently locking them together by a patented chemical and thermal process. The fiber crimp is said to give the fabric added tensile strength and resilience.

According to the producer, the nylon material readily absorbs

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This lustrous vinyl-coated rack resists the scalding water and detergents of automatic dishwashing, prevents clattering and chipping of delicate china.

For bassinets, metal play pens, children's furniture . . .

For soft, colorful seating . . . for table tops . . .

For leather-like stair-well filler, protective screening . . .

For premium slip-proof garment hangers and sox stretchers that won't rust or tear . . .

Colorful, leathery coatings for wire and expanded steel

Tough leather-like coatings of vinyl can create profitable new markets for you with wire and expanded steel products. Colorful coatings up to 1/16″ (60 mils) thick can be deposited on heavy wire, rod stock, or expanded steel in *one dip*. Or by *spraying* it on.

You can make the elastomeric coatings soft and rubbery—or as hard as tire casing. Make the finishes glossy, matte, or even *crinkled*. And in any color you choose. The characteristics of the final coating are determined by the formulation. After spray or dip application, a short heat cure "sets" the resin and permanently bonds it to the metal.

Write for sources of vinyl in liquid form for coating metal, glass, or wood. Get a head start on investigating the new, profitable ways to use wire and expanded steel—vinyl coated for resilience, color and premium appearance. Write today!

Monsanto manufactures a wide variety of plasticizers and Opalon® resins for formulators of these high-quality vinyl dispersions.

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This aluminum casting is part of a missile fuel pump. Its 5/16" walls must pass a 1500 psi pressure test with no impregnation permitted. Interior walls are smooth and true as cast.

If your processing equipment requires parts with demanding metallurgical properties, close tolerances and intricacy, our unique foundry techniques may provide a solution. A number of demanding parts for nuclear and chemical applications have already been cast. Send for our illustrated technical booklet.

Morris Bean & Company
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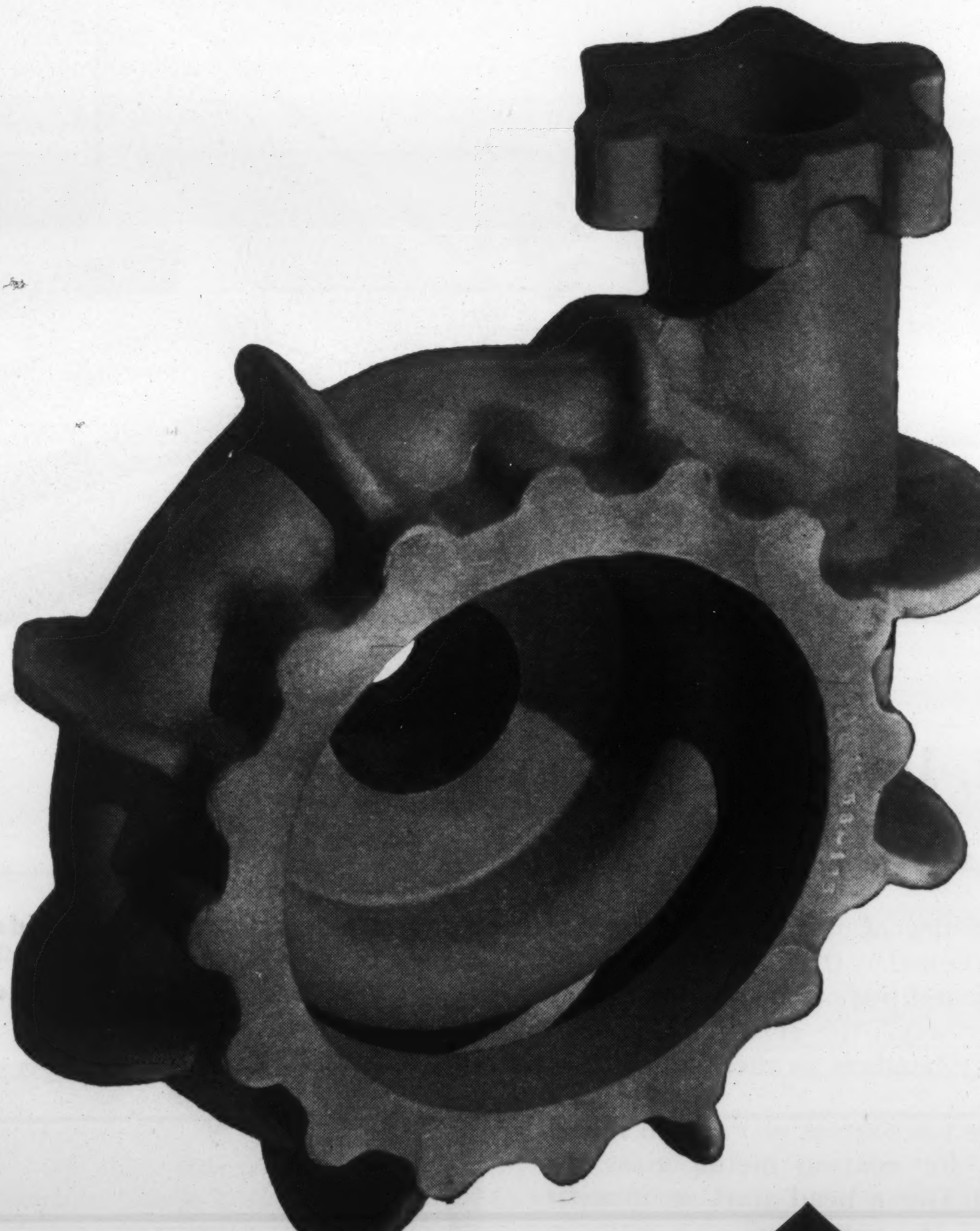

BEAN

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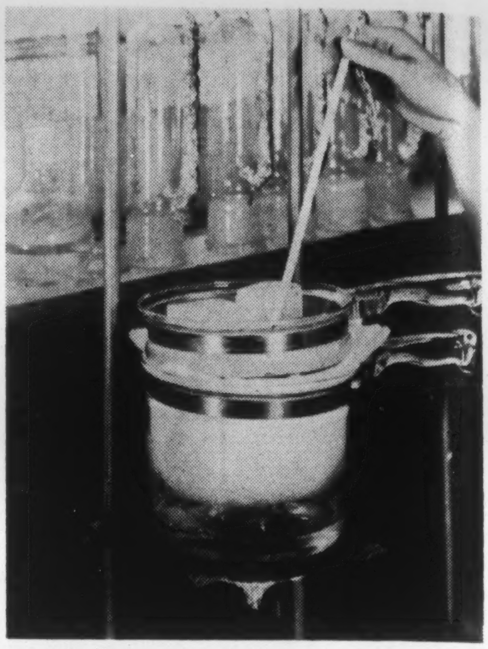


Nylon fabric *shows good insulating properties in hot-cold test.*

vibrations; softens an impact; is antifungus and antimildew; dries rapidly; is resistant to alkalies and most acids; and is dimensionally stable under extreme conditions of cold and of heat up to the melting point of nylon itself. It withstands continuous temperatures up to 300 F and can be laminated or stitched to other materials by heat treating processes. However, because of its strength, the material can be used independently of supporting substances in most applications.

Tests show that the material does not mat and that it is water resistant after repeated immersions. It can be die cut and impregnated with any chemical that is compatible with nylon. It is produced in a range of weights from 2 to 8 oz per sq yd and is available in any width up to 55 in.

Polyester Film Balloon Breaks Altitude Record

A weather observation balloon made of polyester film has established a new altitude record of 142,900 ft. The previous record was 120,000 ft made with a balloon of conventional material.

The advantages of polyester

For more information, Circle No. 571 ➤

film in this application are claimed to be high strength and light weight. The polyester film balloon weighs 109 lb, compared with 550 lb for a conventional balloon of like size. In addition to its light weight the film also shows good impermeability to helium gas, used to raise the balloon.

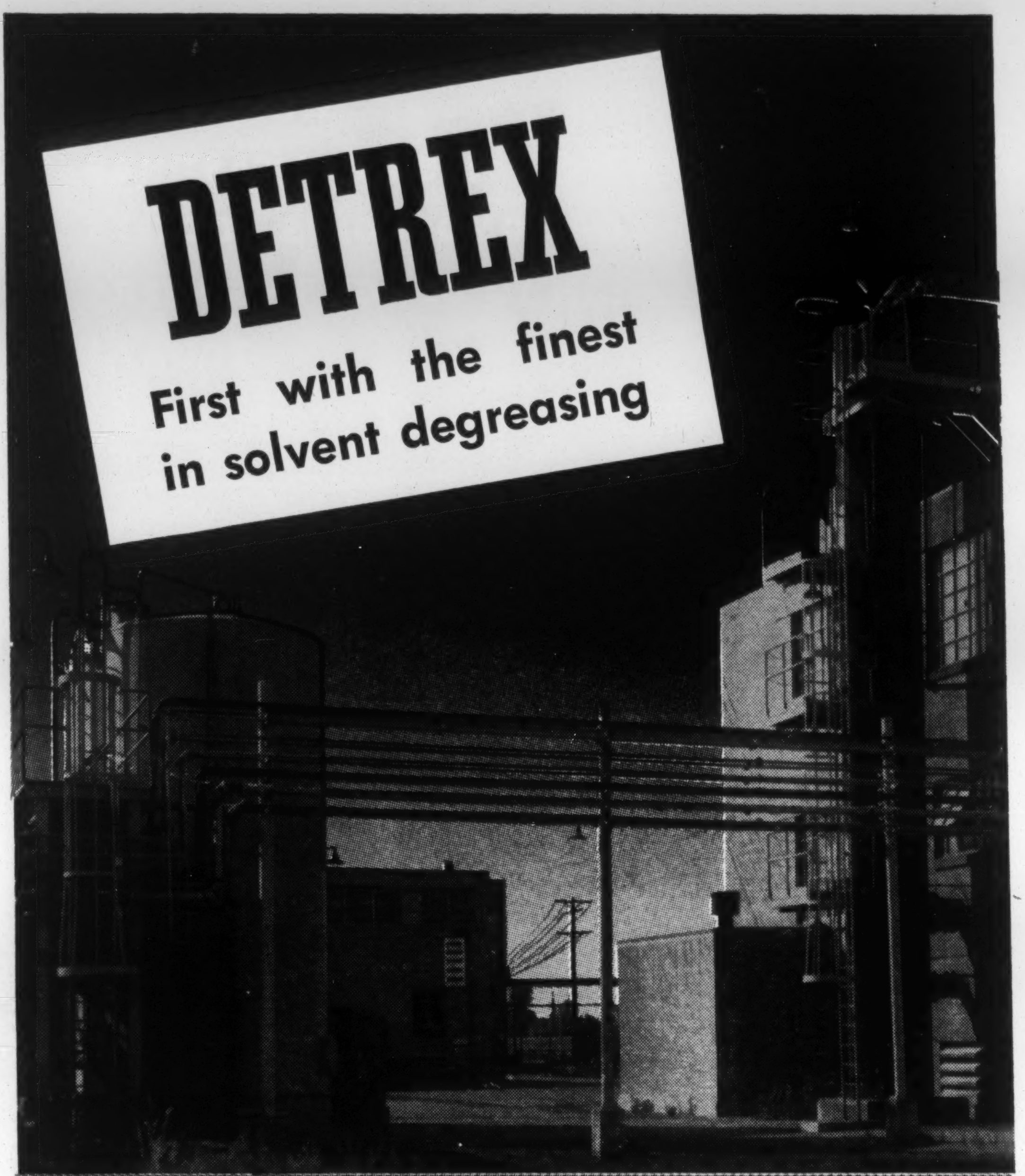
Future balloons made of polyester film are expected to better the present altitude record by thousands of feet. The balloons may also play an important part in long range weather forecasting.

Effects of Brazing at High Temperatures

During the last five years interest has been growing steadily in high temperature brazing of heat resistant alloys. Advancements in dry hydrogen furnace brazing techniques have attracted the attention of many engineers and designers. With furnace brazing it is possible to fabricate intricate parts and assemblies that would be otherwise impossible. The use of lightweight sheet metal components for turbojet engines, for example, depends largely on successful furnace brazing.

However, high temperature brazing of thin sheet metal assemblies presents a serious problem. Although little difficulty is encountered in obtaining adequate joint coverage and shear strength, testing and metallographic studies reveal damaging effects on the base metal.

As a result, Walter E. Russell and John P. Wisner, Lewis Flight Propulsion Laboratory, conducted a study to investigate: 1) the effect of various brazing temperatures on both the tensile strength of sheet specimens coated with braze and the shear strength of brazed joints; 2) the effect of



NEW PERM-A-CLOR®
sets new standards for solvent stability

New DETREX PERM-A-CLOR* trichlorethylene degreasing solvent - stabilized to a new high degree - has been proven on the toughest of metal cleaning jobs.

New PERM-A-CLOR* - premium grade in every respect - excels in EVERY phase of solvent degreasing. It readily dissolves oils, greases, fats and waxes, yet will not attack any industrial metal or alloy. It is safe to use and easy to control. It distills like a pure chemical compound. And most important, its high stability assures longer solvent life and the substantial savings that result.

DETREX, pioneer in all phases of metal cleaning and processing, uses its experience and facilities to bring increased efficiency to any degreasing, washing or coating operation. Write today for detailed information on the wide range of DETREX machines, materials and services. There is a perfect combination to meet your requirements.

*Perm-A-Clor is the registered trademark of DETREX Chemical Industries, Inc.

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BOX 501, DETROIT 32, MICHIGAN

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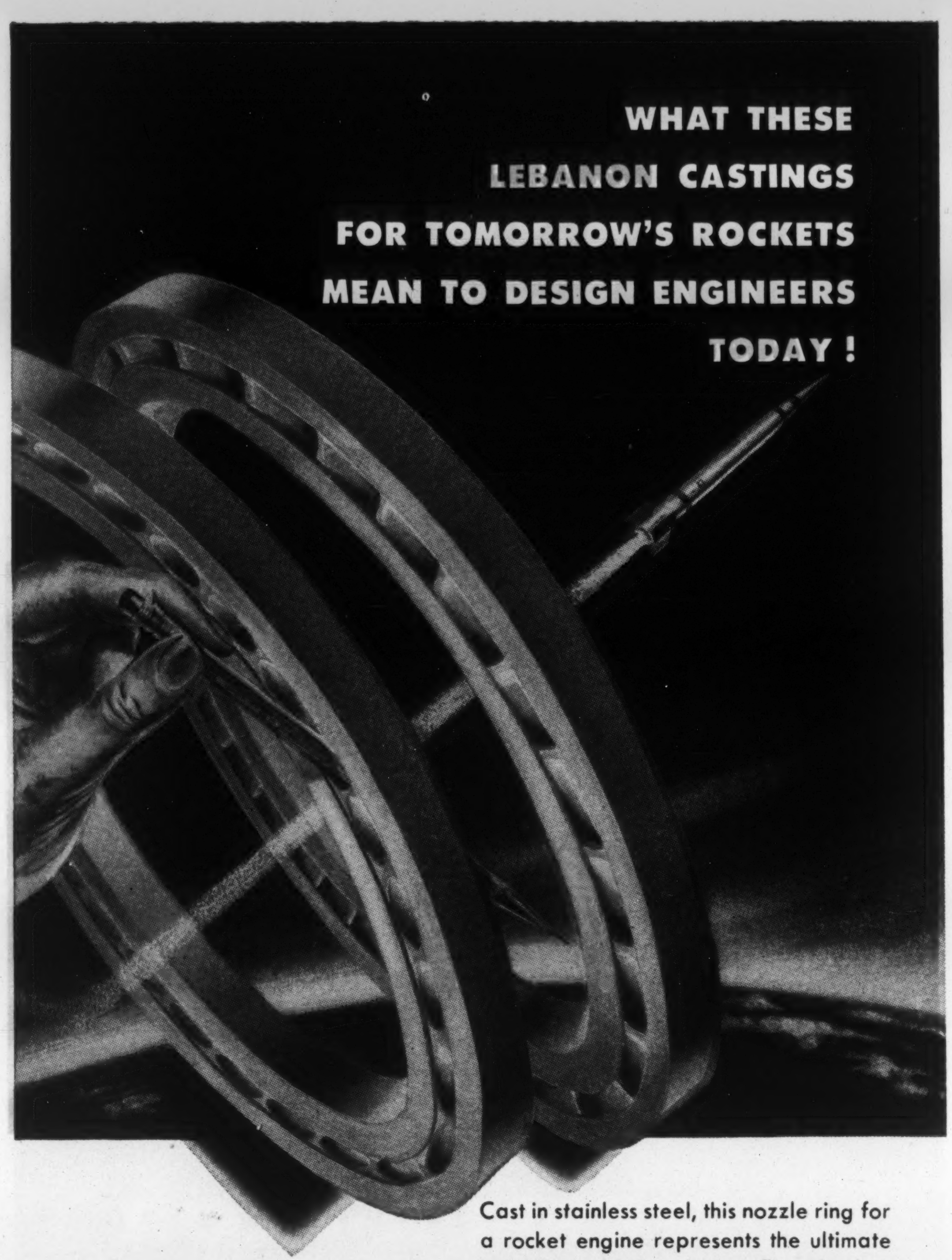


WHAT THESE LEBANON CASTINGS FOR TOMORROW'S ROCKETS MEAN TO DESIGN ENGINEERS TODAY!

Cast in stainless steel, this nozzle ring for a rocket engine represents the ultimate in intricate casting design. The absolute accuracy of core placement, its close tolerances, its thin metal sections, its internal quality—these exacting requirements foreshadow the foundry techniques of tomorrow, now being employed at Lebanon *today*.

THIS CAST NOZZLE RING FOR REACTION MOTORS will help power a rocket into outer space. With the successful production of this casting, Lebanon Steel Foundry stands at the very frontier of its industry.

What significance does this have for you? Simply this . . .

If your project utilizes cast steel in any form, you will gain by contacting Lebanon Steel Foundry during its initial design phase. Our superior knowledge and experience is available to you at the time when they can most effectively produce quality improvements and cost savings.

The most difficult casting requirements—close tolerances, smooth surfaces, dimensional accuracy, intricate metal sections and internal integrity—are being met daily at Lebanon, and this vast fund of foundry know-how is available to you.

Send us your blueprints. Our foundry engineers welcome the opportunity to share their experience with you.

CIRCLE L

Write for Lebanon's Design File "F"

LEBANON STEEL FOUNDRY
113 LEHMAN STREET LEBANON, PENNSYLVANIA
CARBON, LOW ALLOY AND STAINLESS STEEL CASTINGS

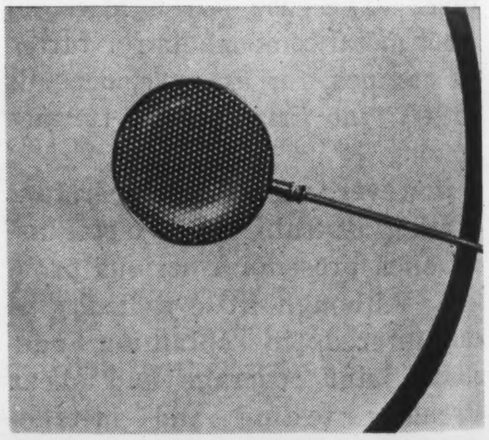
For more information, turn to Reader Service Card, Circle No. 480

time at the brazing temperature on these same properties; and 3) ways to minimize base metal damage and yet provide adequate shear joint coverage and strength.

Four brazing alloys were used. They were essentially nickel-chromium alloys with varying additions of silicon and boron. In *Technical Note* 3932 of the National Advisory Committee for Aeronautics, the investigators reported that:

1. When boron-bearing braze is applied to the central area of the gage section of sheet tensile specimens and the specimens are pulled in tension at 1200 F, tensile strength and ductility of the sheet decrease appreciably as a result of braze penetration during the brazing cycles investigated. This base metal damage becomes greater with increasing temperature and time of the brazing heating cycle. The amount of damage varies with the four base alloys.

2. When boron-free braze is applied, tensile strengths and ductilities of three of the four base metals are generally the same as



Color TV tube mask—An aperture mask, consisting of a paper-thin metal sheet into which are etched 400,000 perfect holes, guide electron beams to the right phosphor dot (red, blue and green) on 21-in. color television tubes. Each hole in the mask is 0.001 in. in diameter and is made to precise size, shape and location so that the right beam hits the right dot.

HAYNES Alloys solve the *tough* heat problems

Searing

2,000 degree jet blast!

The jet engine tailpipe of the Navy's A4D "Skyhawk" operates at extremely high temperatures. That is just one of the many reasons why this vital part is made of MULTIMET alloy.

This HAYNES alloy was selected for its high strength-to-weight ratio, as well as its exceptional performance at high temperatures. MULTIMET alloy provides greater resistance to burnout and erosion than any other material considered for this application.

Aircraft and other industries rely upon HAYNES alloys for use in after-burner components, turbine blades, jet engine tailpipes, nozzle vanes, cabin heaters, and a vast variety of other high-temperature applications.

For booklet or detailed information, write or phone any of the HAYNES STELLITE offices listed below.

. . . Strong, Light-Gauge MULTIMET Alloy Saves 22% Tail Section Weight. One of the longest jet engine tailpipes made on a production basis is installed in the record-breaking A4D "Skyhawk" Navy attack bomber. The pipe is formed of 0.025-in. sheet.

HAYNES STELLITE COMPANY
Division of Union Carbide Corporation
UC
General Offices and Works, Kokomo, Indiana
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HAYNES
TRADE-MARK
ALLOYS

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For more information, turn to Reader Service Card, Circle No. 380

those of specimens that have no braze but have been given the same braze heating cycle. In the case of the fourth, Inconel X, some reduction in tensile properties is noted, but the reduction is less than for the boron-bearing braze.

3. At 1200 F shear joints of specimens brazed with the boron-bearing braze in vacuum and hydrogen are somewhat stronger than joints brazed with boron-free braze. The difference varies for the four base metals.

4. Shear specimens brazed in hydrogen with both types of brazing alloy exhibit more erratic joint coverage by the brazing alloy than those brazed in vacuum. The data indicate, however, that vacuum and hydrogen brazed shear specimens are equivalent in strength.

5. Alloys that can be age hardened and contain titanium and aluminum can be successfully brazed in vacuum by first electroplating with nickel. For hydrogen brazing, however, addition of flux to the brazing alloy is more reliable than plating. Flux additions are ineffective during vacuum brazing.

6. The electroless type of nickel plate enhances flow and joint coverage on alloys that can be age hardened and contain titanium and aluminum, but it has an adverse effect on base metal strength and ductility, as well as on joint shear strength.

Black Polyethylene Is Weather Resistant

A black polyethylene resin, designated Alathon 5F, has been introduced commercially by E. I. duPont deNemours & Co., Inc., Wilmington 98, Del., as a film and paper coating resin for applications where resistance to outdoor weathering is important.

The resin is a medium density

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VALVES, SLIDES and SEAL NOSES

Eliminate failures—Due to swelling, warping, sticking and gumming. Morganite is chemically inert, imparts no taste, odor or colors—provides trouble-free operation in the presence of high temperatures and pressures, oil, water, corrosive chemicals, gases. Proven-in-service on food machinery, fuel pumps, liquid meters, compressors, enameling conveyors, jet engine pumps, pipe lines, process equipment.

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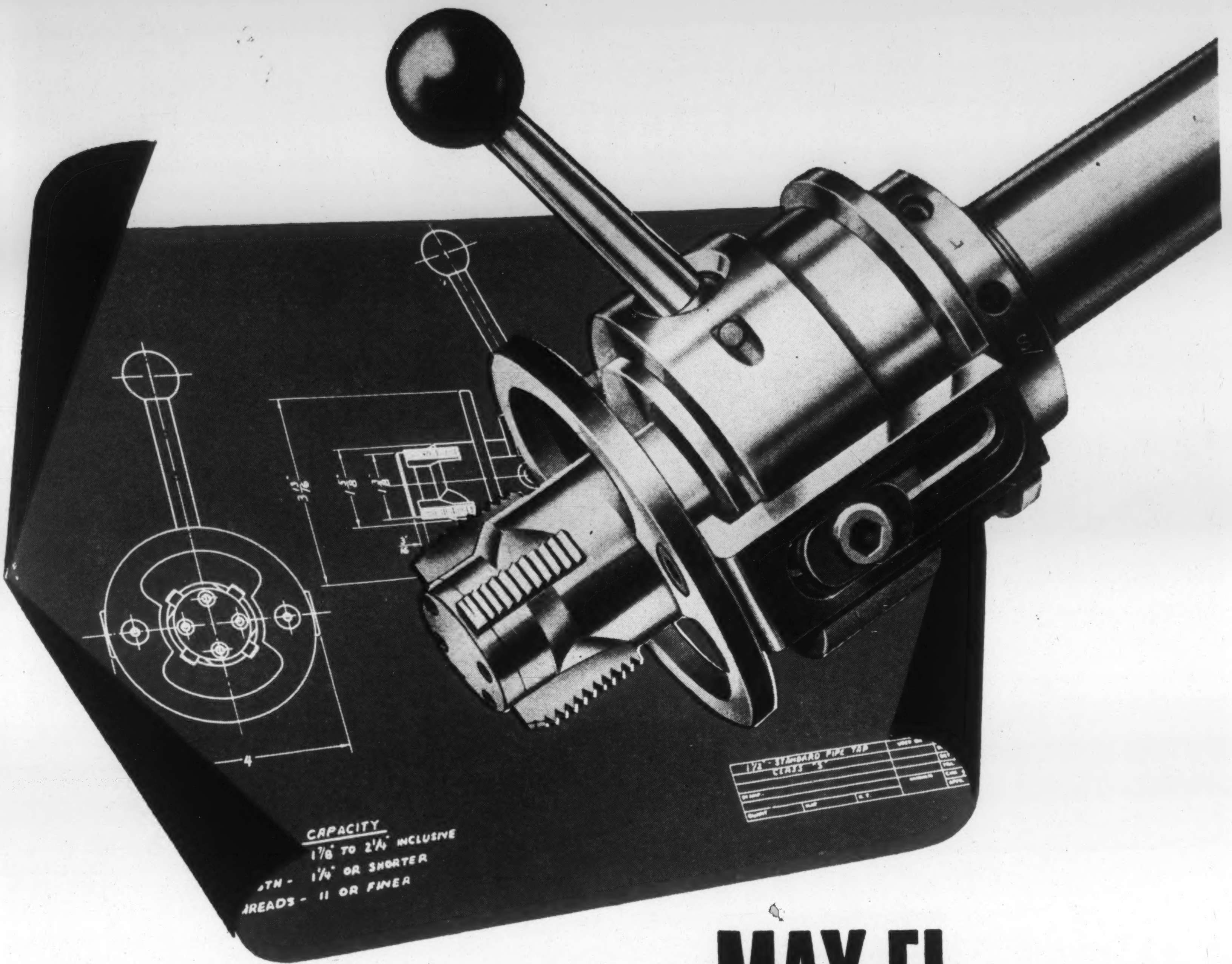


Universal collapsing tap parts of **MAX-EL** alloy steel finish machined after full heat treatment

Considerable machining is required in the manufacture of parts for these taps. That's why Crucible MAX-EL® 3½ free machining alloy steel was chosen by the Geometric Tool Company, Division of Greenfield Tap and Die Corporation. For with MAX-EL you can rough machine, *then* heat treat even intricate parts before final machining *with no danger of distortion of the steel.*

But the best way to check the advantages of MAX-EL is to try it in your own shop. Like many other users you'll appreciate its superior machinability, freedom from distortion, deep hardenability characteristics, uniformity and quality. And you'll like the longer tool life you get by using MAX-EL.

For complete data . . . and *quick delivery* of MAX-EL alloy steels, from local warehouse stocks, call *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

For more information, turn to Reader Service Card, Circle No. 441

now... design with CEMENTABLE TEFLON

TAPES • SHEETS

- **Readily bonded to metal, wood, plastics, glass, etc.**
- **Provides smooth unblemished surface.**
- **Requires no mechanical fasteners.**
- **Permits use of economical thicknesses—tapes and thin sheets.**
- **Same outstanding electrical, chemical, mechanical and thermal properties as regular TEFLON.***

Electrical and Electronic Applications:

Dielectric base for printed circuit material; motor windings and coil forms; dielectric shields for electronic chassis and components; hermetic sealing of components, etc.

Mechanical Applications:

Anti-friction linings for hoppers, chutes, powder measuring and feeding devices; conveyor and packaging machine guides; bearing liners; non-adhesive work surfaces, machine linings, roll coverings, confectionery molds; ski and skid facings; frictionless surfaces for electro-mechanical instrument, valve, pump and machine parts, etc.

Cementable TEFLON is offered with surface treatment on one or both sides. Ask your nearest Garlock district office or write for literature—

*du Pont trademark.

United States Gasket Company
Camden 1, New Jersey

United States Gasket *Plastics Division*
OF THE GARLOCK PACKING COMPANY

For more information, turn to Reader Service Card, Circle No. 565

material containing a carbon black dispersion. The carbon black protects the polyethylene film against degradation caused by sunlight. According to duPont, the carbon black dispersion is comparable to that found in the best black films used in electrical applications.

Suggested applications for film made of the new polyethylene formulation include conveying and storing irrigation water; protecting harvested crops from weather; and a light barrier for use in packaging sensitive materials.

The price of Alathon 5F black polyethylene resin is 37½¢ per lb in truckload quantities.

Molybdenum Disilicide Holds Up at 3002 F

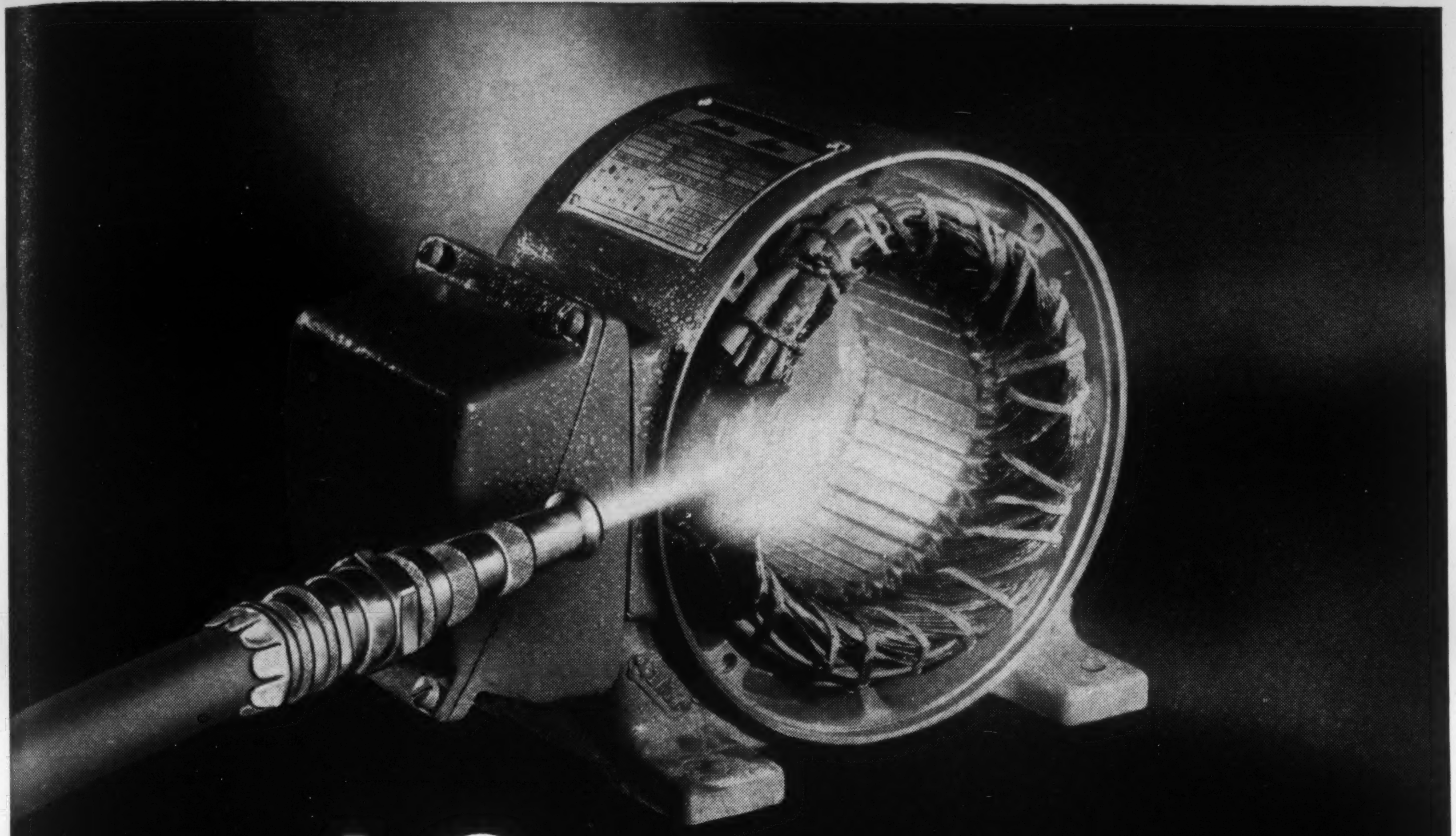
Molybdenum disilicide heating elements are said to perform successfully at temperatures as high as 3000 F. The alloy, manufactured by Fansteel Metallurgical Corp., is described as a hard, brittle material of intermediate density, high compressive strength and good electrical conductivity (see accompanying table).

Molybdenum disilicide is supplied either as a powder or in dense shapes. In massive form the alloy is suitable for heater elements, ignition electrodes, nozzles, thermocouple shields and balls for attrition mills. In powdered form the alloy is potentially

PHYSICAL PROPERTIES OF MOLYBDENUM DISILICIDE[a]

Density, lb/cu in.	0.22
Rockwell Hardness	
Room Temperature	A87.0
1020 F	A83.7
1130 F	A80.6
1200 F	A80.3
Melting Point, F	3632[b]
Modulus of Rupture, psi	65,000
Tensile Strength, psi	40,000
Compressive Strength, psi	333,000
Electrical Conductivity, % IACS	6.1-5.9
Electrical Resistivity, microhm-cm	28.3-29.3
Coef of Ther Exp, per °F	5.1×10^{-6}

[a] At 68 F unless otherwise specified.
[b] Decomposes at the melting point.



10 REASONS

WHY WESTINGHOUSE *BONDITE* VARNISH IS SUPERIOR TO ALL OTHER CONVENTIONAL TYPES...

for all Class "A" and "B" Applications

1. **BONDITE** is *saturated throughout* with silicone, upgrading the excellent properties of the other resins in the varnish.
2. **BONDITE** not only repels *surface-moisture* — its resistance is effective *throughout the cured mass!*
3. **BONDITE** retains its high dielectric strength at high temperatures in continuous service.
4. **BONDITE** meets MIL-V-1137 A specification, Type M, Grade CB.
5. **BONDITE** is fully thermosetting, providing excellent through cure.
6. **BONDITE** uses *low toxicity* naphtha as the thinner.
7. **BONDITE** offers *superior oil resistance* for dry type *and* oil immersed transformers.
8. **BONDITE** ASTM Flex Life or Heat Endurance, is nearly *double* the life of most conventional varnishes.
9. **BONDITE** is a product of Westinghouse Research — with an outstanding record of proven performance.
10. **BONDITE** has flexibility in application . . . it's available in consistencies for either dipping or impregnation.

J-06656

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Company ______________________
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For more information, turn to Reader Service Card, Circle No. 516

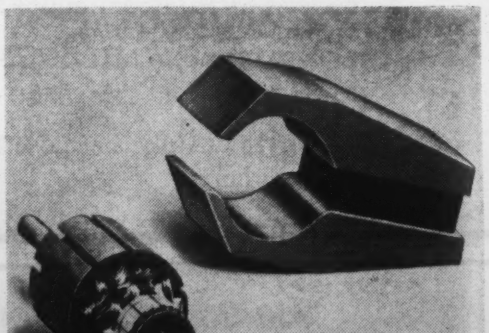
useful as an abrasive for the preparation of oxidation resistant castings and in the manufacture of cermets.

The material is prepared by direct synthesis from molybdenum and silicon metal powders, which combine exothermically at elevated temperatures to produce $MoSi_2$. The reaction product is pulverized to an optimum particle size distribution and then pressed into compacts. The compacts are sintered at high temperatures to produce the hard, dense alloy.

Because molybdenum disilicide is hard and brittle, fabrication of the alloy is difficult. Although it can be ground or cut using silicon carbide or diamond wheels, efforts to weld or cast it have proved unsuccessful.

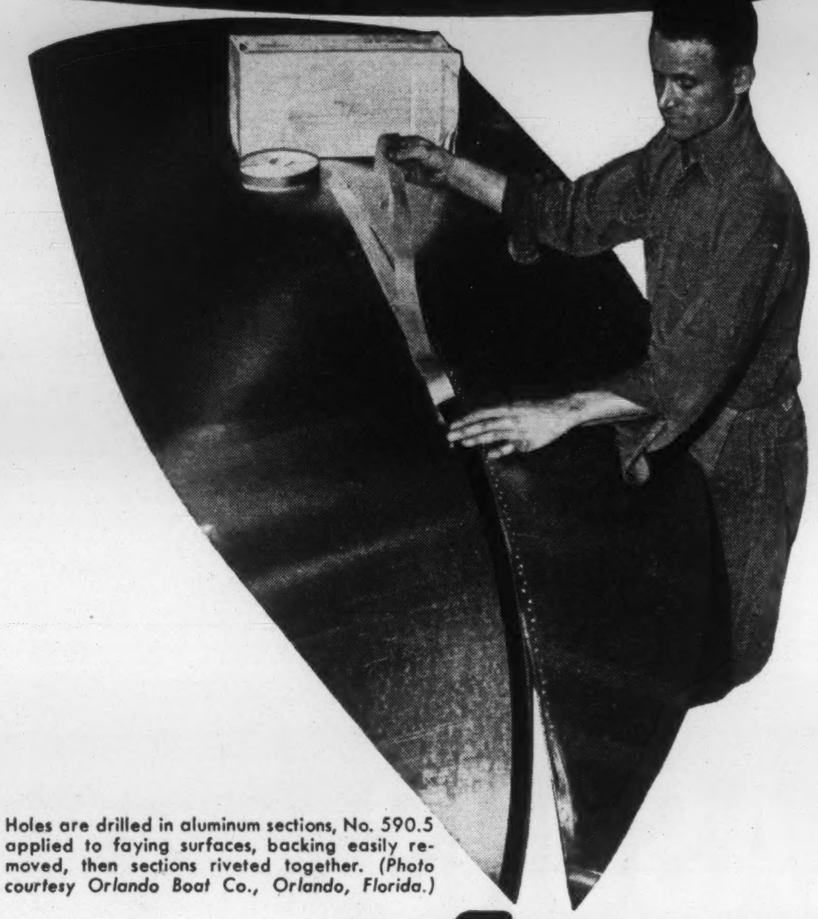
Permanent Magnet Is Small, Lightweight

A new, oriented ceramic permanent magnet, called Indox V, is said to have an extremely high peak energy product (1920 gauss Bd, 1820 gauss Hd) and is said to make possible substantial savings in both magnetic material and space. Developed by Indiana Steel Products Co., Valparaiso, Ind., magnet is made of a newly developed ferrite magnetic material that contains no critical elements. Its properties include a coercive force (Hc) of 2000 oersteds, a



***Electromagnetic stator** (right) illustrates use of new ceramic magnet.*

For more information, Circle No. 442 ➤



how to
LEAKPROOF A BOAT...

...or any product made of aluminum, steel, glass or plastics

Holes are drilled in aluminum sections, No. 590.5 applied to faying surfaces, backing easily removed, then sections riveted together. (Photo courtesy Orlando Boat Co., Orlando, Florida.)

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oil, gasoline, water resistant sealers

On water, on land or in the air, Presstite-Keystone's No. 590.5 Seam Sealing Tape forms a permanently watertight and leakproof seal that will not dry out or crack, retains its plastic characteristics to —65°F., and is resistant to gasoline or oil. Nor will it craze plastics. It's easy to use, too . . . no mess or clean-up.

Extruded in convenient roll form, No. 590.5 is always of uniform thickness. Available from .020″ to .0625″ thick and widths from ½″ to 3″.

No. 590.5 is an aircraft-type sealer and complies with Military Specification Mil-S-7126a.

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PRESSTITE-KEYSTONE ENGINEERING PRODUCTS COMPANY
KAP
A Division of AMERICAN-MARIETTA COMPANY
3916 CHOUTEAU AVENUE, ST. LOUIS 10, MISSOURI

For more information, turn to Reader Service Card, Circle No. 398

moving metal... BLUE ANGELS' style

U. S. NAVY PHOTO

With maximum separation of five feet between each plane, the "Blue Angels" demonstrate precision tactical techniques of naval aviation at speeds of 500 mph and better. This famous team of Navy pilots has thrilled millions of aviation enthusiasts with its "minimum altitude" performances of close order precision flying.

To a constantly increasing number of manufacturers, particularly aircraft and jet engine builders, moving metal by The Cincinnati Milling Machine Company's *Hydroforming* and *Hydrospinning* processes is equally dramatic. Formerly difficult-to-make aircraft, engine, missile and other components are being produced in rapid development time . . . with savings of 50% and more in tooling, materials and labor. These part shapes range from simple to highly complex, formed from a wide range of metals. For detailed information on Hydroforming and Hydrospinning, call in a Process Machinery Division field engineer.

CINCINNATI® 19" HYDROFORM®

JET ENGINE PART of 22 gage Inconel, Hydroformed in two operations. A punch, contoured to the part shape, and a simple draw ring, were the only tools required. Hydroform machines are built in 8", 12", 19", 23", 26" and 32" sizes.

CINCINNATI 42" x 50" HYDROSPIN®

NOZZLE, Hydrospun from a wrapped and welded tube (shown at right) of AISI 4130 steel in four passes. Hydrospun parts, having undergone a severe shear deformation, possess increased strength, hardness and resistance to fatigue.

CINCINNATI
Hydroform · Hydrospin

PROCESS MACHINERY DIVISION
THE CINCINNATI MILLING MACHINE CO.
CINCINNATI 9, OHIO, U. S. A.

TEFLON*

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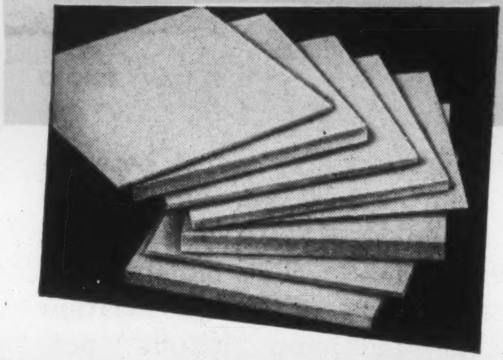
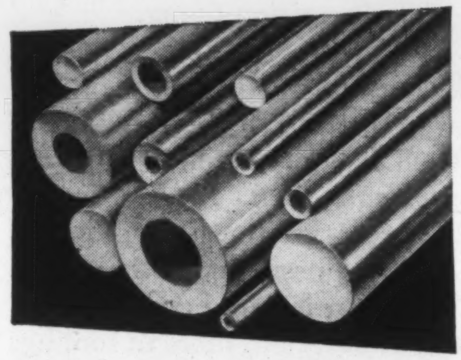
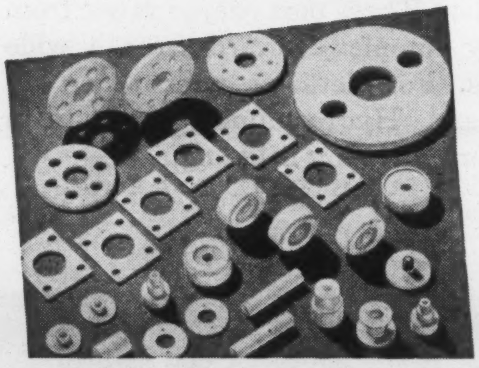
TUBING....MOLDED OR MACHINED PARTS?

YOU CAN GET JUST WHAT YOU WANT

from JOHN CRANE







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*TEFLON *DuPont trademark*

Advantages:

CHEMICAL—Completely inert
ELECTRICAL—Extremely low power factor
Very high dielectric strength
THERMAL—Temperature range
—300°F. to +500°F.
MECHANICAL—Strong, flexible
Weather resistant
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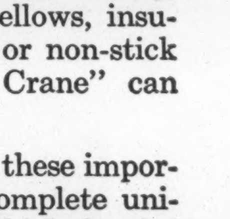

JOHN CRANE CRANE PACKING COMPANY 38 YEARS INDUSTRIAL PROGRESS

OFFICES IN ALL PRINCIPAL CITIES

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residual induction (Br) of 3840 gauss and an electrical resistivity of 10,000 to 20,000 ohm-cm.

According to the company, the product's light weight (0.181 lb per cu in.) makes it comparable to Alnico V magnets on an equivalent weight basis. The area of Indox V magnets is said to be 57% less than that of conventional nonoriented ceramic magnets.

It is recommended for synchronous drives, d.c. motors, traveling wave tubes, high fidelity loud speakers and magnetic clutches.

Epoxy for Sealing, Lightweight Tools

A low density epoxy casting resin, designated Stycast 1090, is being marketed by Emerson & Cuming, Inc., 869 Washington St., Canton, Mass. The material is recommended for use in making lightweight plastics tools and as a sealant. According to the producer, Stycast 1090 may be cured at room temperatures to produce a unicellular material that has low dielectric constant and low dissipation factor. Moisture absorption is said to be negligible. The new epoxy resin is said to be useful over a temperature range of –70 to 400 F.

Improved Insulation Withstands High Heat

An improved ceramoplastic insulating material, known as Supramica 560, has been announced by Mycalex Corp. of America, 125 Clifton Blvd., Clifton, N. J.

The Supramica line of synthetic mica-filled plastics, developed in 1954, is said to withstand higher temperatures than natural mica because of the replacement of hydroxyl groups by fluorine in the synthesis. The improved prod-

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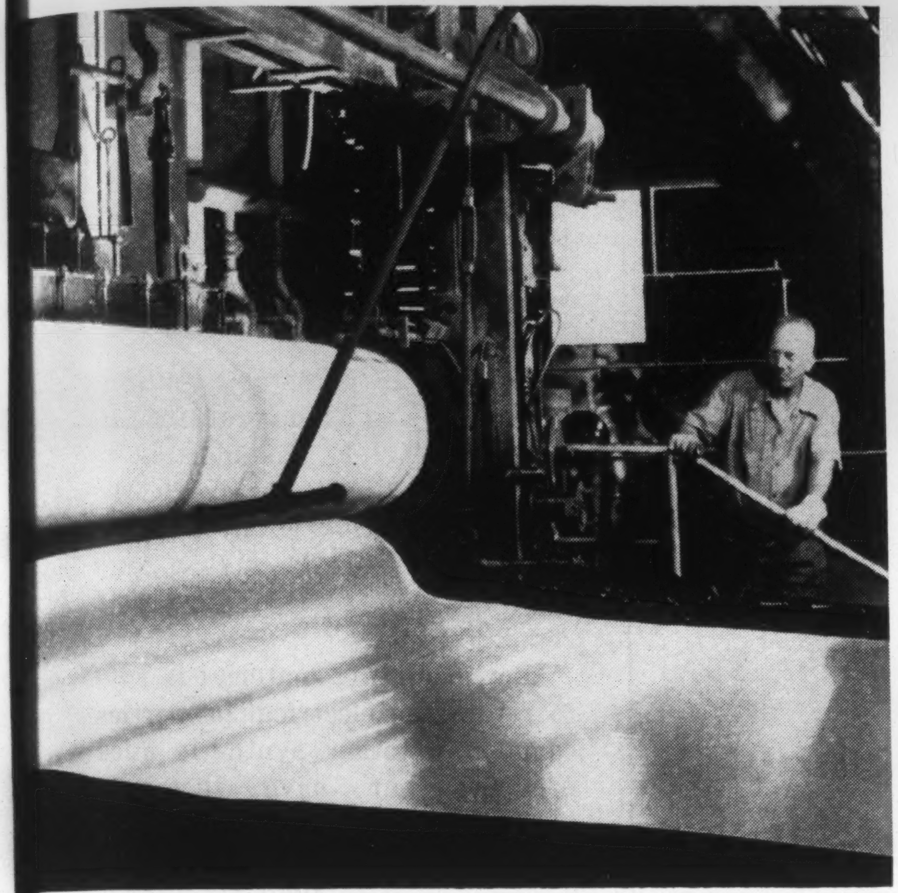
NOTHING *can equal Stainless Steel in its unique combination of properties*



No other design material can match Stainless Steel in its combination of desirable properties: corrosion resistance, strength, hardness, beauty, cleanability and easy fabrication. If you're looking for a reliable source of supply, remember that United States Steel offers you the widest range of types, finishes and sizes.

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PIPE • TUBES • WIRE • SPECIAL SECTIONS

UNITED STATES STEEL

For Heat Resistance

Pittsburgh Plate Glass Company wanted to increase the output of their glass tanks, so they needed better rolls to withstand the heat from the 2000° F. glass. They chose USS Stainless Steel Forgings for this critical location because Stainless resists cracking and oxidation, and retains its dimensions, even though in 24-hour-a-day service.

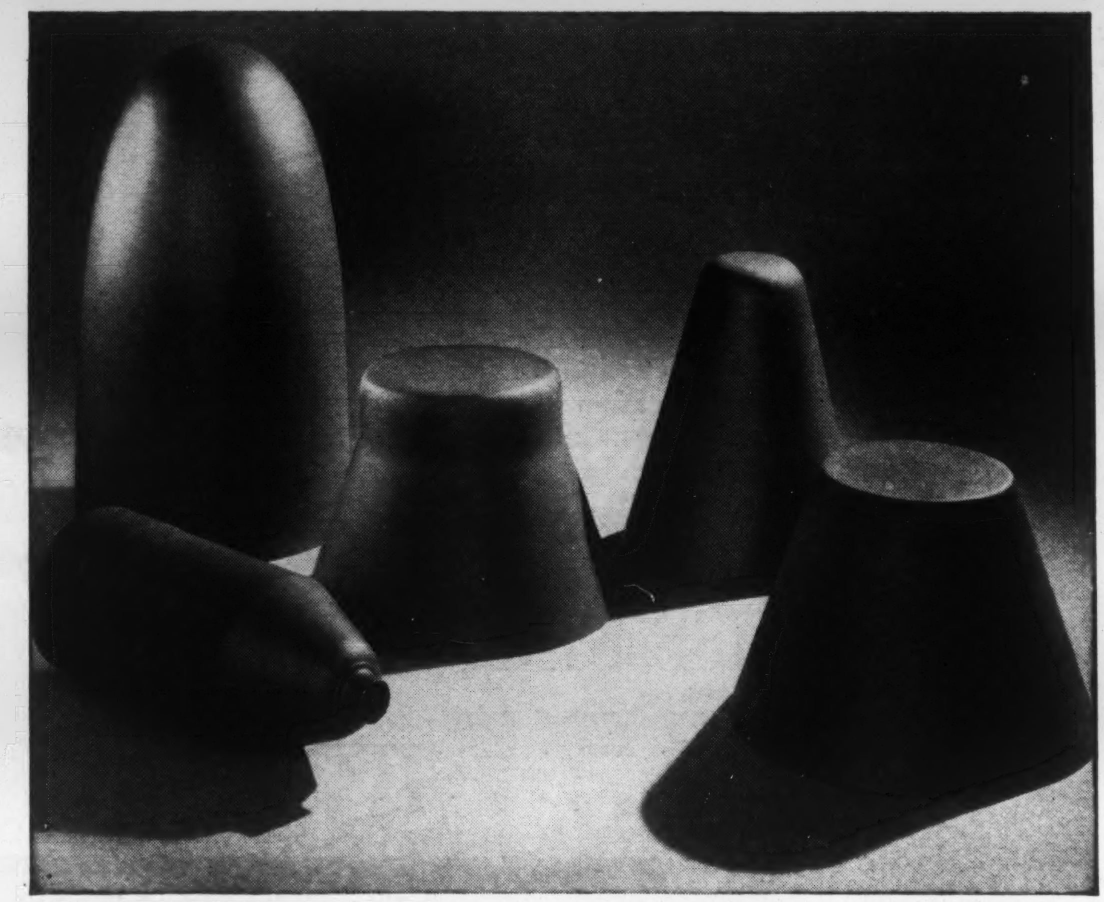
For Corrosion Resistance

Calera Mining Co. operates the world's largest cobalt refinery, and the process involves leaching with a sulfuric acid solution. The Stainless Steel agitators shown here hold up at temperatures as high as 200° F., despite the high acid concentrations.

For Durability

The nationally famous Norwalk Truck Lines have been using Stainless Steel trailers since 1941 and *they've never had one wear out.* Although the Stainless trailers cost a little more initially, Norwalk gladly pays the difference because the trailers never have to be painted, and they never rust out underneath.

ORWALK
NORWALK
5324
B-P 847
9-K 75



What you ought to know about deep drawn shapes and shells

Hackney deep drawn shapes and shells permit product designers to reduce weight, save production time and lower unit costs—improve product appearance, increase strength and vibration resistance. Our experience in producing O.E.M. parts for manufacturers of many types of equipment can help you achieve similar results. Just keep these basic specifications in mind:

Shapes: Cylindrical, spherical, tapered or conical.

Capacities: From 1 quart to 70 gallons.

Diameters: From 3 inches up to 32 inches.

Depths: Up to 60 inches. Two half shells are easily welded together for extra length or symmetrical design. Open end can be closed by spinning to give an entirely seamless cylinder.

Blank thicknesses: 16 gauge and heavier.

Wall thickness: For working pressures up to 5,000 psi in the smaller diameters—up to 200 psi in the larger diameters.

Metals: Steel, stainless steel, nickel, aluminum, magnesium, copper and many alloys.

Write for details.

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Branch offices in principal cities
DOWNINGTOWN IRON WORKS
CONTAINERS AND PRESSURE VESSELS FOR GASES, LIQUIDS AND SOLIDS

For more information, turn to Reader Service Card, Circle No. 409

PROPERTIES OF SUPRAMICA 560

Specific Gravity	2.8
Rockwell Hardness	M125
Water Absorption (24 hr), %	Nil
Dissipation Factor (1 mc)	0.0035
Dielectric Constant (1 mc)	6.8
Loss Factor (1 mc)	0.024
Volume Resistivity, ohm-cm	5×10^{13}
Coef of Ther Exp (68 F), F	13×10^{-6}

uct is said to withstand continuous operating temperatures in excess of 930 F. In addition to its improved heat resistance, the material is also radiation resistant, dimensionally stable, and lighter in weight than its predecessors.

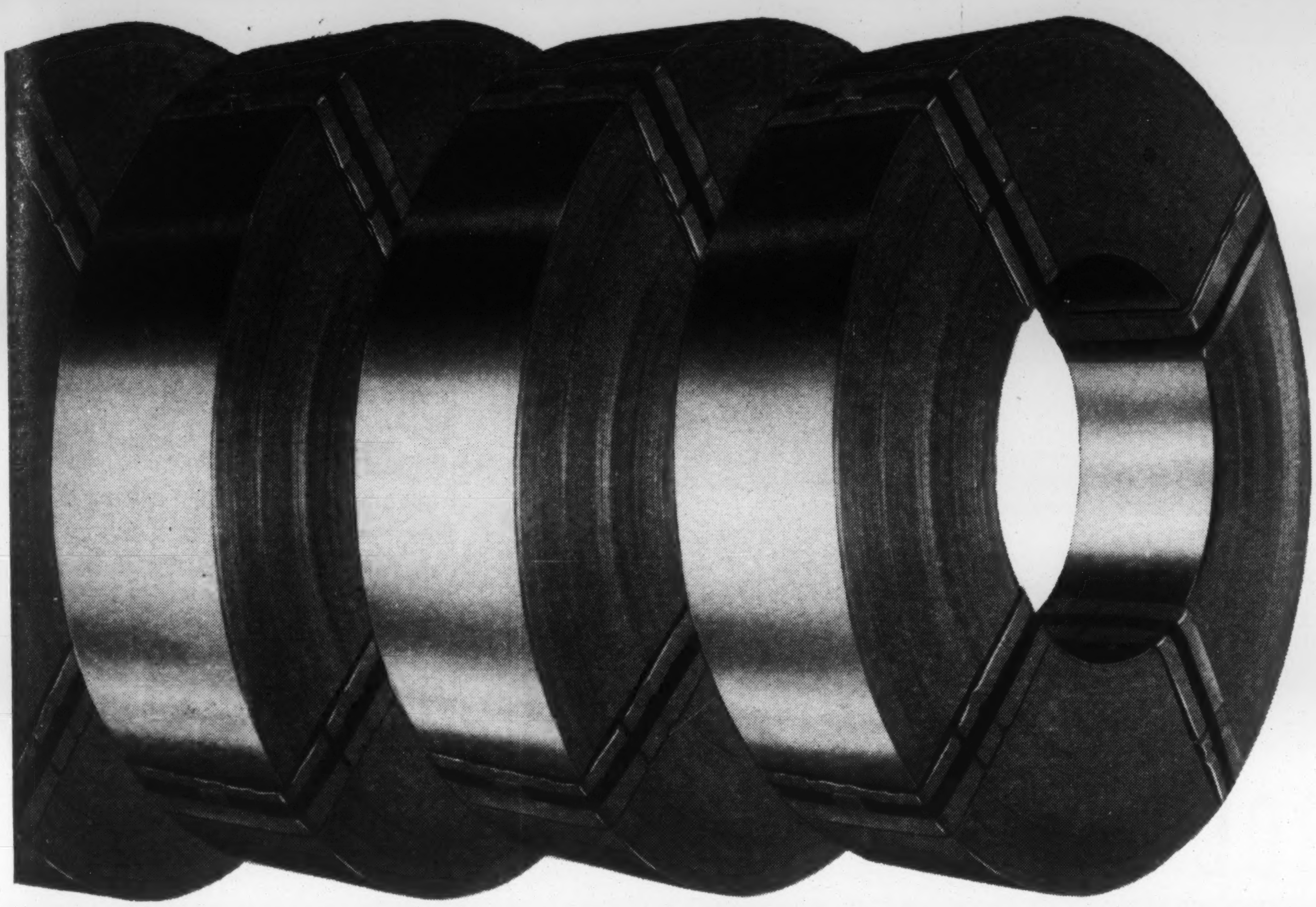
The insulating material is said to retain the electrical properties common to other synthetic mica products but have increased thermal endurance. Short time maximum operating temperature is approximately 1200 F, depending on the mass and configuration of the part.

The material can be precision molded to close tolerances and is dimensionally stable during and after fabrication. Functional or reinforcing inserts may be permanently molded into the material without harming its inherent properties. The material is recommended for parts used in aircraft and guided missiles.

Colored Hardeners for Epoxy Resins

Colored hardeners for epoxy resins have been introduced by Furane Plastics Inc., 4516 Brazil St., Los Angeles 39, Calif., to enhance the decorative appeal of epoxy resins and to aid in epoxy part identification. The hardeners are offered along with the company's line of epoxy casting and laminating resins in red, blue, yellow, green, orange and black colors.

It is possible to add colored hardeners to an epoxy resin and determine from visual inspection



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And you're sure of *quality* from Crucible—*fine finish . . . better edges . . . improved flatness.*

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The Oliver Building, Mellon Square,
Pittsburgh 22, Pa.

I'd like a copy of your 32-page booklet on cold rolled specialty steels.

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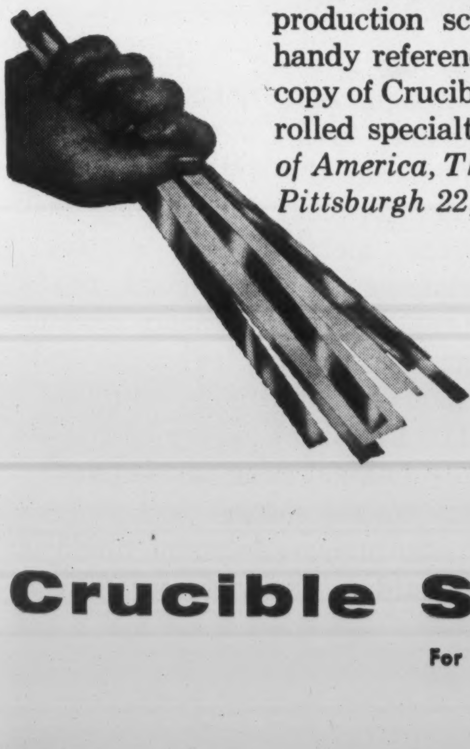

CRUCIBLE first name in special purpose steels

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MOLYBDENUM
TUNGSTEN-NICKEL
MOLY-NICKEL

SUPER ALLOY CONTROL

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FANSTEEL REFRACTORY METAL PELLETS

Low cost, readily available, high density, low gas content, easily handled, and ...

99.8% PURE

Write for current data

K575A

FANSTEEL METALLURGICAL CORPORATION
NORTH CHICAGO, ILLINOIS, U. S. A.

For more information, turn to Reader Service Card, Circle No. 506

whether or not thorough and adequate mixing of the resin has taken place. Striations, streaks and uneven color distribution indicate that the resin was not properly mixed. Use of the colored hardeners in epoxy resins, therefore, may offer better quality control for epoxy parts than present methods.

According to the producer, the colored hardeners have been evaluated in contact with the skin over long periods of time and have been found to be nondermatitic.

Improved Coatings for Metals, Wood

Four new and improved coatings have recently been introduced for use on wood and ferrous and nonferrous metals.

1. White enamel resin

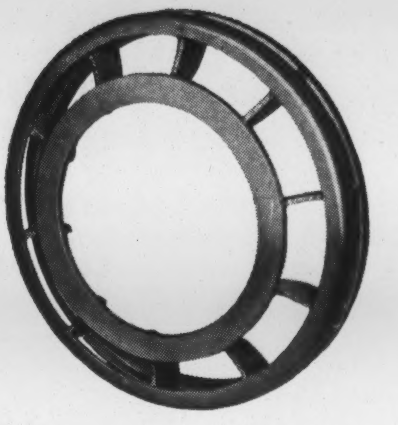
An improved urea-formaldehyde resin for white baking enamel formulations has been introduced by Rohm & Haas Co., Washington Square, Philadelphia 5. Called Uformite F-222, the resin is said to impart good gloss and hardness, accelerate baking speed, and increase resistance to food and water stains. Enamels made with the new resin are said to be particularly adapted for use on kitchen cabinets, refrigerators, hospital equipment and steel furniture.

2. Metallizing coating

Logo, Inc., 12933 South Stony Island Ave., Chicago 33, has announced the introduction of a new top coat for vacuum metallized metals. The coating is claimed to have good physical properties and abrasion resistance and is capable of withstanding 1500 hr of 100% humidity at 110 F. Exact nature of the coating has not been disclosed.

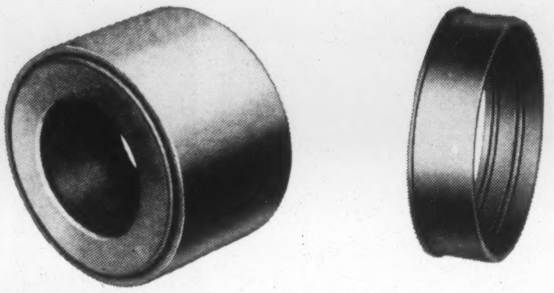
3. Marine finish

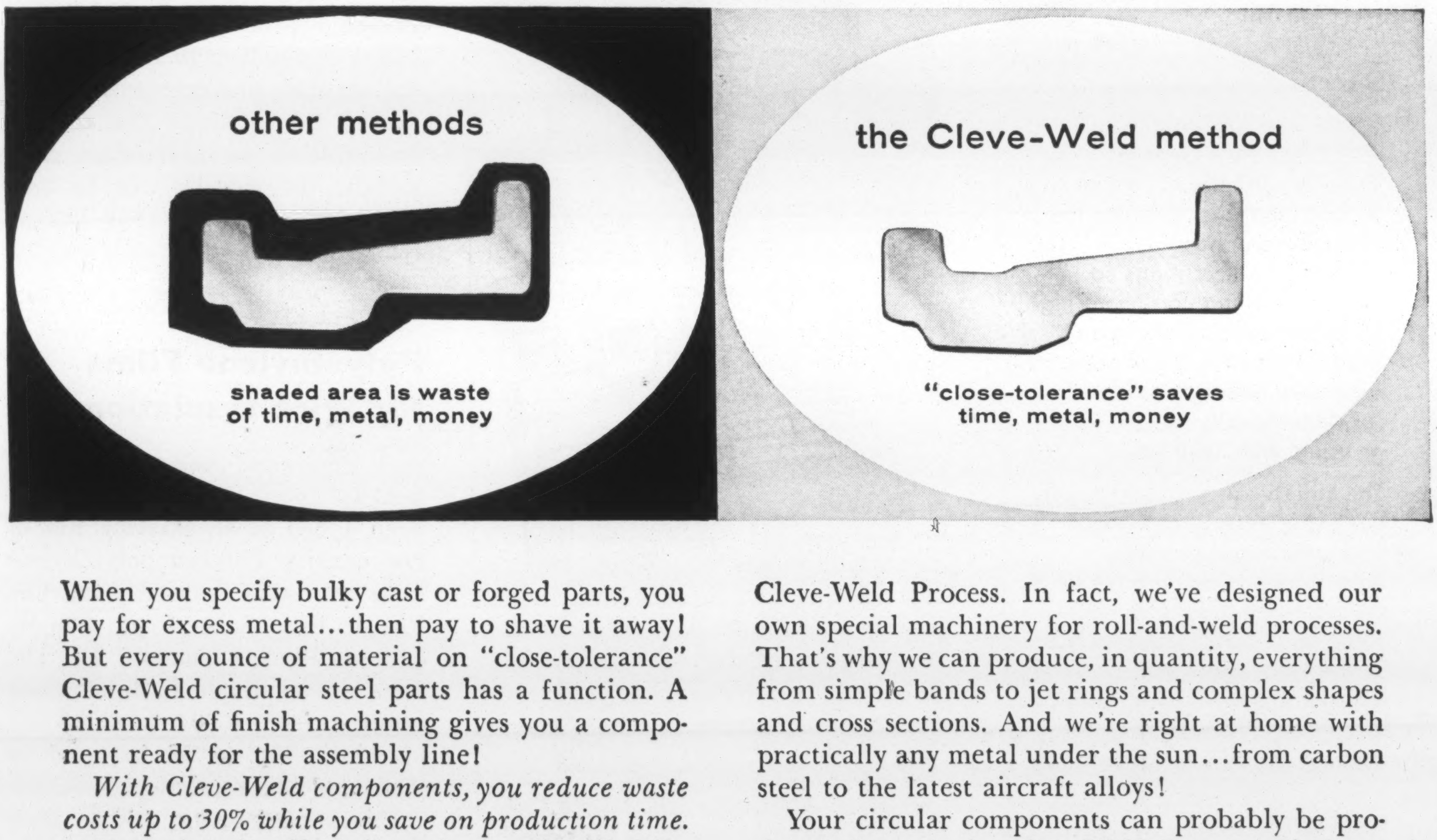
An improved marine finish that is said to eliminate scraping and



START CLOSER TO THE FINISHED PRODUCT...

...with Cleve-Weld "close-tolerance" circular welded components!




other methods
shaded area is waste of time, metal, money
the Cleve-Weld method
"close-tolerance" saves time, metal, money

When you specify bulky cast or forged parts, you pay for excess metal...then pay to shave it away! But every ounce of material on "close-tolerance" Cleve-Weld circular steel parts has a function. A minimum of finish machining gives you a component ready for the assembly line!

With Cleve-Weld components, you reduce waste costs up to 30% while you save on production time.

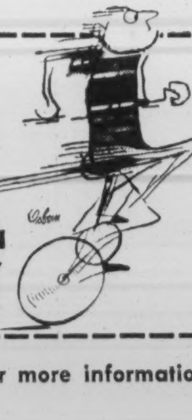
If your specs call for "wonder metals" like titanium, the material and machining time we can save you will probably pay for the whole Cleve-Weld part!

Over 45 years of welding specialization backs the Cleve-Weld Process. In fact, we've designed our own special machinery for roll-and-weld processes. That's why we can produce, in quantity, everything from simple bands to jet rings and complex shapes and cross sections. And we're right at home with practically any metal under the sun...from carbon steel to the latest aircraft alloys!

Your circular components can probably be produced through the Cleve-Weld Process! Find out how Cleve-Weld can cut costs and improve performance for your products...write, call or send drawings to Circular Welded Products Sales Department, at the address shown below!

Another AMF Product
CLEVE-WELD PROCESS
RIMS · RINGS · WELDMENTS

CLEVELAND WELDING DIVISION
AMERICAN MACHINE & FOUNDRY COMPANY
Cleveland 11, Ohio



Waste not! Wait not! Mail this coupon today!

I'd like a brochure on Cleve-Weld metallurgical, design and production facilities... telling how Cleve-Weld Process parts give better performance at lower cost. MM-706

NAME____

TITLE____

ATTACH TO YOUR COMPANY LETTERHEAD AND MAIL.

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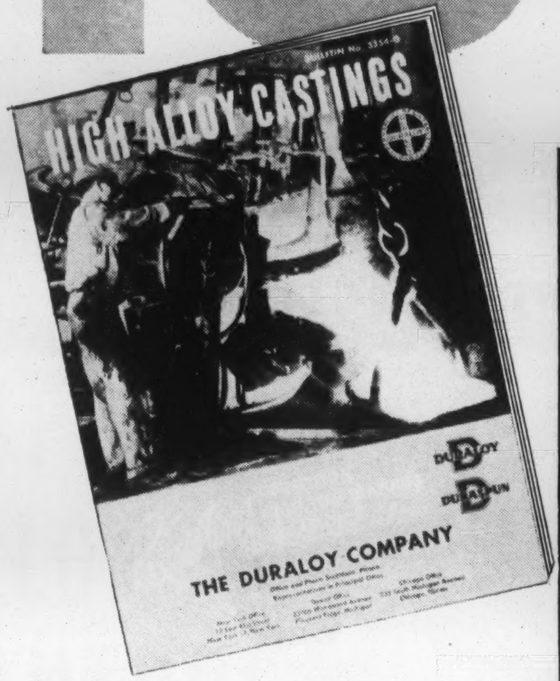
16 pages of useful information about



HIGH ALLOY CASTINGS

DURALOY DURASPUN

This is our New General Bulletin—3354G. It's full of information and data on the chrome-iron and chrome-nickel castings so necessary when corrosion, high temperatures and abrasion must be resisted. It will serve as a general selection guide for those specifying or using such castings.

The bulletin also reviews briefly our experience in both static and centrifugal castings, an experience going back to the pioneering days of 1922 and 1933 respectively. It also tells about our facilities for furnishing castings to any desired analysis, welding, X-ray and gamma ray testing, metallurgical and foundry control.

Typical Castings
Standard Designations
Stress-Temperature Curves for Selected High Alloys
High Temperature Strengths for High Alloy Castings
CASTINGS

WRITE or CALL our nearest office for a copy.
We believe you will find it helpful in your work.

The DURALOY Company
OFFICE AND PLANT: Scottdale, Pa.
EASTERN OFFICE: 12 East 41st Street, New York 17, N. Y.
ATLANTA OFFICE: 76—4th Street, N.W.
CHICAGO OFFICE: 332 South Michigan Avenue
DETROIT OFFICE: 23906 Woodward Avenue, Pleasant Ridge, Mich.

For more information, turn to Reader Service Card, Circle No. 501

sanding of rusted metals has been developed by Surface Coating Engineers, Inc., 272 Doremus Ave., Newark, N. J. Called Vinylon, the finish is said to give complete waterproof protection to metal surfaces, wood, fiberglass, aluminum and canvas.

4. Zinc-base coating

A zinc-base coating for both ferrous and nonferrous metals has been introduced by Danton Corp., 339 Auburn St., Auburndale 66, Mass. Called Galvoplate, the metallic coating consists of 95% pure zinc and provides cathodic protection to the base metal. According to the producer, no special pretreatment is required for applying the coating. In addition to protecting clean metals, the coating can be used to arrest corrosion that has already started.

Polyethylene Films for Wire Insulation

A series of calendered, high density polyethylene films has been added to an existing line of low density Polyken polyethylene films available from Kendall Co., Plastic Film Sales Dept., 309 W. Jackson Blvd., Chicago 6, Ill. The films are available in thicknesses ranging from 0.004 to 0.025 in., in widths up to 32 in., and in clear and black colors.

Films containing 100% high density polyethylene and blends of this material with low density

PROPERTIES OF POLYKEN POLYETHYLENE FILM

Color	Clear
Specific Gravity	0.92
Tensile Strength, psi	
Machine Direction	60
Transverse Direction	22
Elongation, %	
Machine Direction	58
Transverse Direction	5
Low Temperature Flexibility Limit	—130 F
Dielectric Strength, v/mil	20,000
Dielectric Constant	2.32
Power Factor	0.002

No. 3

of a series of ads dealing with basic facts about thermostatic metals.

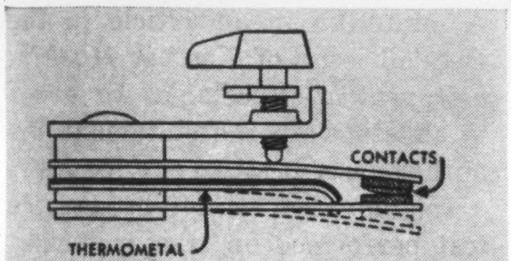
Designing for Product Improvement With WILCO THERMOMETAL®

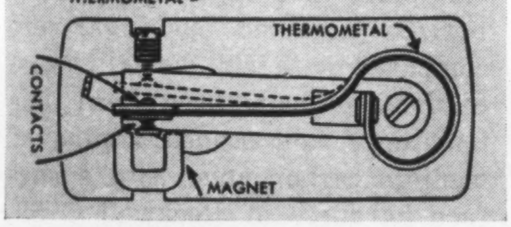
Thermometal in Temperature Control

Of the several methods of temperature control used in today's industrial and consumer electrical products, Thermometal-actuated units account for a major portion. The reason is–these units offer certain exclusive features which are reflected both in improved design and improved performance in the end product.

Thermometal is a composite material of two or more different metals with unequal coefficients of expansion. This difference causes it to change shape (flex) with changes in temperature, thereby translating temperature change directly into motion.

FLATIRON THERMOSTAT





ROOM THERMOSTAT

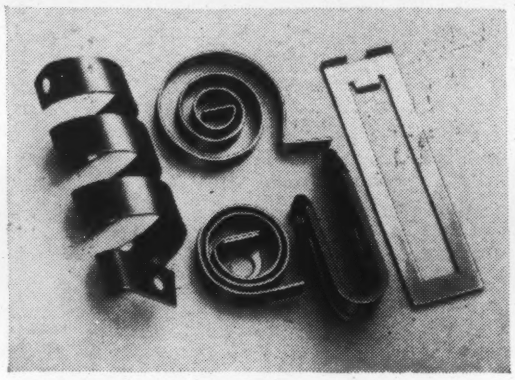
Thermometal is ideally suited for use in temperature controls because:

1. It amplifies temperature change response into motion with no need for complicated linkages such as are used in rod and tube thermostats, or of fluid systems such as diaphragms and bellows.

2. Inherent *economies* resulting from its use in electrical appliances cannot be matched by any other method of temperature regulation.

3. Thermometal facilitates extremely compact design, so that the control unit can be brought close to the source of heat to be controlled. One example of this is the sole plate of an electric iron.

4. With Thermometal, the temperature of an electrically heated source can be controlled without using additional electrical energy in the bi-metal, as is required in operating a thermopile.



Forms in which Thermometal are used

Since Thermometal can be rolled into any thickness and formed into almost any shape it is a unique thermo-responsive element. It enables the design engineer to apply it in the form of cantilever blades, "U" shapes, spirals, and helices, and in almost any mechanical size and configuration according to the physical needs of the temperature control unit. Thus, it is singularly free from many of the limitations of other thermal elements. Typical examples of this are bimetal thermostats in flat irons and room thermostats.

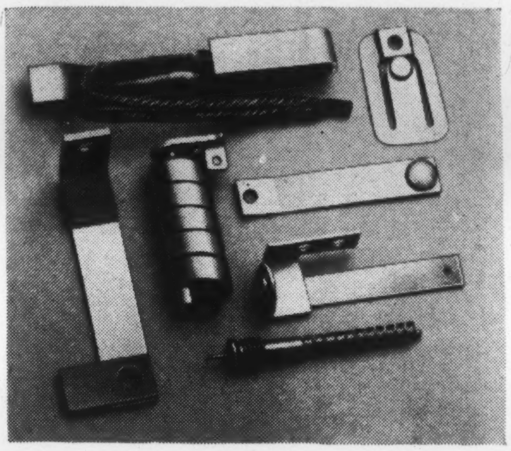
Factors governing selection

1. Temperature range over which control is required.

2. Maximum and minimum temperature encountered in service.

3. The amount of work (Force times Deflection) to be performed by the Thermometal.

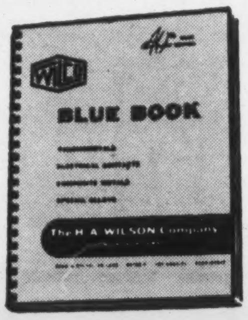
4. Electrical and thermal conductivity required of the Thermometal.



TYPICAL WILCO THERMOMETAL SUB-ASSEMBLIES

The H. A. Wilson Company, American pioneer in the development and manufacture of thermostatic metals, produces over 40 varieties of Thermometal, as well as a complete line of electrical contacts. In many temperature control units both Thermometal and electrical contacts are used. We make a specialty of supplying complete sub-assemblies for these devices, including mounting brackets, pigtails, and other current-carrying members.

Reprints of this series are available on request. For further information about our products, ask for the Wilco Blue Book, the most complete reference manual ever written on Thermometal. And if you have any immediate application problem for Thermometal or other Wilco products, please tell us. Our engineering service is at your disposal.



WILCO®

THERMOMETALS
ELECTRICAL CONTACTS
COMPOSITE METALS
SPECIAL PURPOSE ALLOYS

THE H. A. WILSON COMPANY
2655 U. S. Route 22, Union, New Jersey
Branch Offices: Chicago • Detroit • Los Angeles • Providence

ENGELHARD INDUSTRIES

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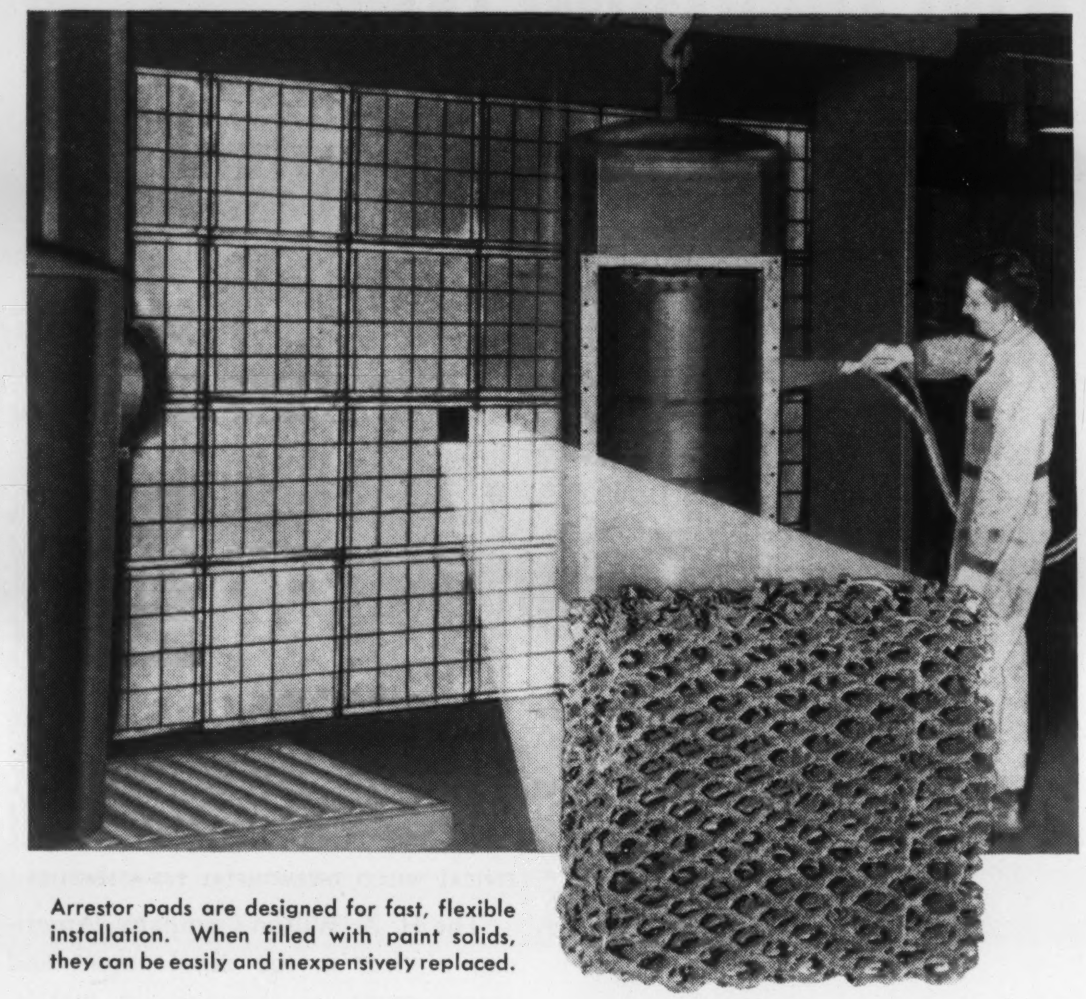
Creative Papers from the mills of Mosinee
. . . are custom-tailored to specific needs . . . particularly yours



Arrestor pads are designed for fast, flexible installation. When filled with paint solids, they can be easily and inexpensively replaced.

Trapping dangerous paint spray with a honeycomb of paper

RESEARCH PRODUCTS CORP., Madison, Wisconsin, produces arrestors that trap non-used paint — both solids and volatiles — in paint spraying operations. Slit and expanded flame-resistant paper are used to fabricate these highly efficient arrestors. Sandwiched together, the sheets form thousands of tiny paint traps to protect both property and equipment.

This research-minded company knew just where to go for the paper to meet their specialized requirements —

MOSINEE! Perhaps there's a job that Mosinee sulphate paper can do equally well for you. If there is, there's no better way to discover it than by talking with a Mosinee consultant. And there's no time like the present for setting the wheels in motion by filling out and mailing this coupon.

Mosinee PAPER MILLS COMPANY

MOSINEE PAPER MILLS CO., Dept. MM-6, Mosinee, Wisconsin
Please furnish details on how you can create special papers to meet our needs.
NAME............ TITLE............
FIRM............
CITY............ ZONE............ STATE............
ADDRESS............
PRODUCT............

For more information, turn to Reader Service Card, Circle No. 471

polyethylene are available. The blended films are said to offer the physical advantages of both high density and low density polyethylenes.

Applications for these products include wire and cable insulation, boilable food packaging and other polyethylene film uses where additional heat resistance is required.

Borized Steel Wears Better Than Tool Steel

Borized carbon steel bushings are almost three times as wear resistant as bushings made of hardened high carbon-high chromium tool steel, according to A. A. Maurakh in an article in the Dec '56 issue of *Vestnik Mashinostroyeniya* (Russian). In order to substantiate the statement the author describes two service tests.

In the first, a 240-hr service test performed on tractor treads, borized pins and bushings were compared with standard links of cast 12% manganese steel (no bushings) and standard pins of medium carbon steel with a surface hardness of Rockwell C 58. The borized layer (0.3-0.4 mm thick) was produced by electrolytically treating a 0.46% carbon steel with a current density of 0.15 amp per sq cm for 4 hr in molten borax at 1725 F. Surface hardness after cooling was 1900 to 2100 Vickers.

Wear resistance of the borized bushings was found to be 17 times greater than that of standard links without bushings, and the borized pins were 12 times more wear resistant that the standard pins.

The second test, a 416-hr service test, compared hardened tool steel bushings with the standard links without bushings. The tool steels included a 1% carbon tool steel, a 1.4 carbon-0.5 chromium-5.0 tungsten-0.25% vanadium steel, and a high carbon-high

It costs no more to buy the best . . .

Buy WOLVERINE...

How do you tell the best?

Well, we can't answer for other products but where tubing is concerned we know you can't do better than specify the products of Wolverine Tube. Here's why.

Wolverine products are Tubemanship built—reflect Wolverine's years of experience, rigid quality control, constant research, sound engineering and the pride its skilled employees take in work well done. The result is tubing of the highest quality and when you buy quality you automatically buy the best.

In addition to top quality, Wolverine Tubemanship also assures you of tubing designed to meet your needs. In heat transfer applications, for example, you can specify condenser tubing in two distinct forms. For heat exchange operations demanding top BTU output Wolverine manufactures Wolverine Trufin®—the integrally finned condenser tube. Also available is prime surface condenser tubing in a wide range of sizes and alloys. Wolverine is also widely known for its top quality commercial tube which is available in types for a wide variety of industrial applications.

The next time you require copper tubing specify Wolverine—and be sure of the best. For the complete story of Wolverine's extensive product line write for your copy of the General Products Catalog. Do it today!

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WOLVERINE TUBE

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Manufacturers of Quality-Controlled Tubing and Extruded Aluminum Shapes

Wolverine Trufin is available in Canada through the Unifin Tube Company, London, Ontario

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EXPORT DEPARTMENT, 13 EAST 40TH STREET, NEW YORK 16, NEW YORK

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Where
Metal
. . . meets its
Sternest
Test

Reactor components, operating submerged in high-temperature and high-pressure radioactive water, are sealed in protective "cans" of *stainless steel.* Pile control rods, exposed to the same conditions, are clad with sleeves of *stainless steel* and are suspended by cables of *stainless steel.*

In any field — nucleonic, aviation, guided missile — where critical specifications *must* be met, Wallingford Steel can fill the need with stainless and super metal strip or tubing of extremely high quality, excellent corrosion resistance and low heat transfer rates.

Whether your need is quality stainless steel, or super metals with special characteristics, Wallingford Steel can help you. Write today.

Progress in Metals
for over 35 Years

THE
WALLINGFORD
STEEL CO.
WALLINGFORD, CONN., U.S.A.

COLD ROLLED STRIP: *Super Metals, Stainless, Alloy*
WELDED TUBES AND PIPE: *Super Metals, Stainless*

For more information, turn to Reader Service Card, Circle No. 505

WEAR OF BORIZED PARTS VS STANDARD PARTS (mm)

	Middle	Outside
Borized Bushings	0.07	0.05
Standard Links (no bushings)	0.88	1.15
Borized Pins	0.08	0.06
Standard Pins	0.85	0.73

chromium steel with 1.25 carbon, 11.5 chromium and 1% vanadium. The best of these tool steels, the high carbon-high chromium type, had a wear resistance about 6.6 times greater than that of the standard links without bushings. Interpolating, the author suggests that the borized bushings, therefore, have wear resistance more than double that of high carbon-high chromium tool steel.

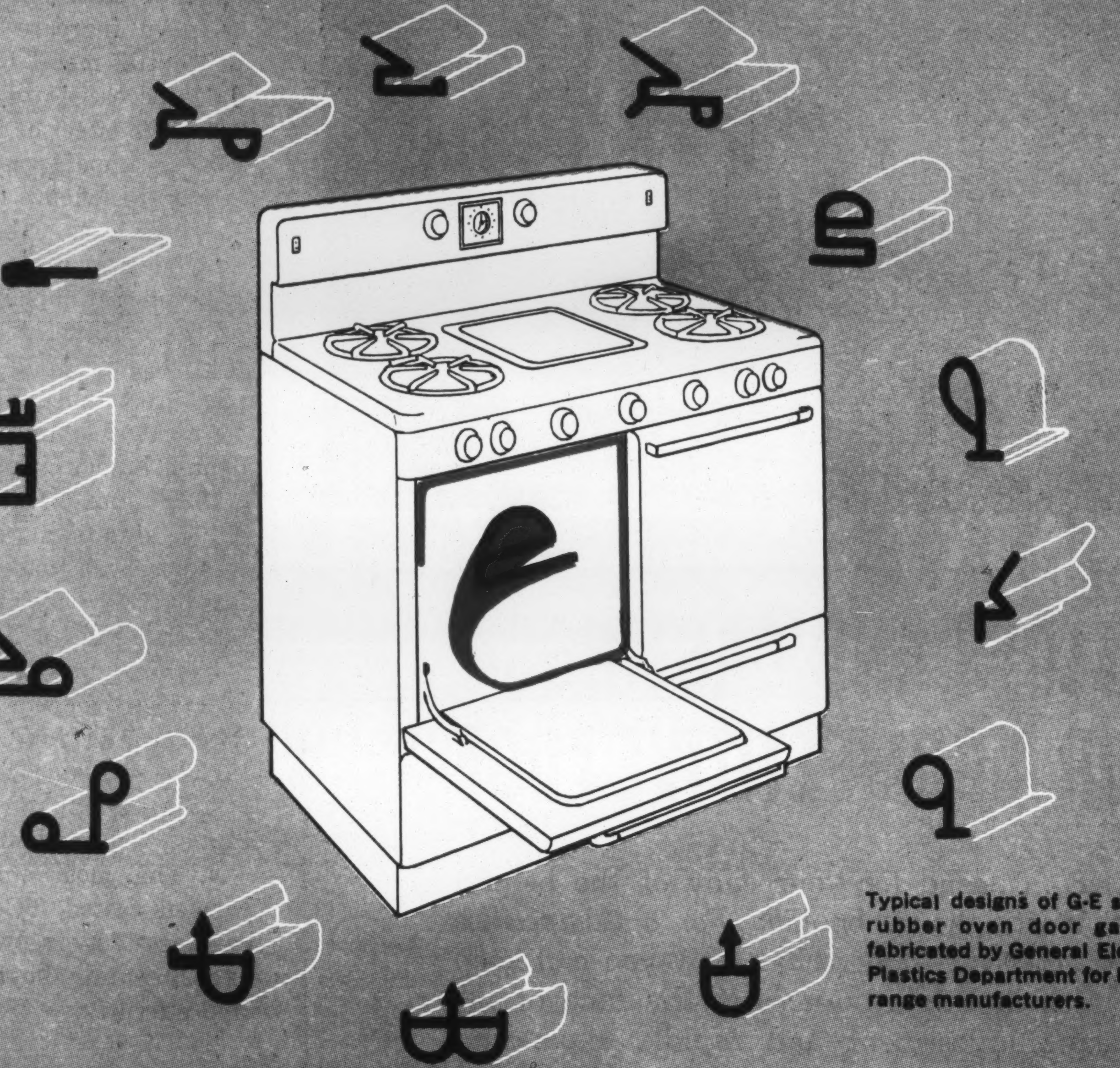
Composition of Cermets vs Impact Resistance

The creep and stress rupture properties exhibited by cermets indicate that their use for jet engine turbine blades may allow increased operating temperatures. However, although encouraging results have been obtained in actual engine runs, it has been noted that upon failure of one cermet blade, adjacent cermet blades are frequently severely damaged by the impact of the blade fragments.

In an attempt to improve the impact resistance of cermets, H. B. Probst and Howard T. Henry, Lewis Flight Propulsion Laboratory, measured the impact energy of 10 titanium carbide-base cermet compositions. Using both notched and unnotched test bars at room temperature and (for some of the materials) at 1200, 1500 and 1750 F, the authors found that a relation exists between the impact resistance and the quantity and nature of metal and carbide phases.

As reported in *Technical Note* 3894 of the National Advisory

Another new product... made better ... with G-E silicone rubber range gaskets



Typical designs of G-E silicone rubber oven door gaskets, fabricated by General Electric's Plastics Department for leading range manufacturers.

LOOKING FOR A NEW SALES PLUS FOR YOUR PRODUCT? Take a tip from the range industry! Many of America's leading range manufacturers now equip oven doors with *silicone rubber gaskets* fabricated by General Electric's Plastics Department. G-E silicone rubber gaskets seal in cooking odors and heat, muffle noisy 'door clang' and prevent stains on the range finish. They typify the way G-E silicone rubber parts can help the appliance industry make better, more salable products.

Where can YOU use G-E silicone rubber parts to make a better product? They have made oven door gaskets a practical reality for the first time! Perhaps they can give *your* appliance some new sales plus or product advantage! Consider G-E silicone rubber parts whenever *heat* is a factor in your designs. They withstand 300-500 F in continuous service, 600 F for intermittent periods. And here's what you can expect when you make General Electric's Decatur, Illinois, plant *your* source for silicone rubber parts: the best silicone rubber on the market today—plus, General Electric application engineering to design, engineer and produce parts that "work."

Write today, on your company letterhead, for a free copy of "Fabricated G-E Silicone Rubber Parts" to **Plastics Department, General Electric Company,** Section 6MM, Decatur, Ill.

Progress Is Our Most Important Product

GENERAL ELECTRIC

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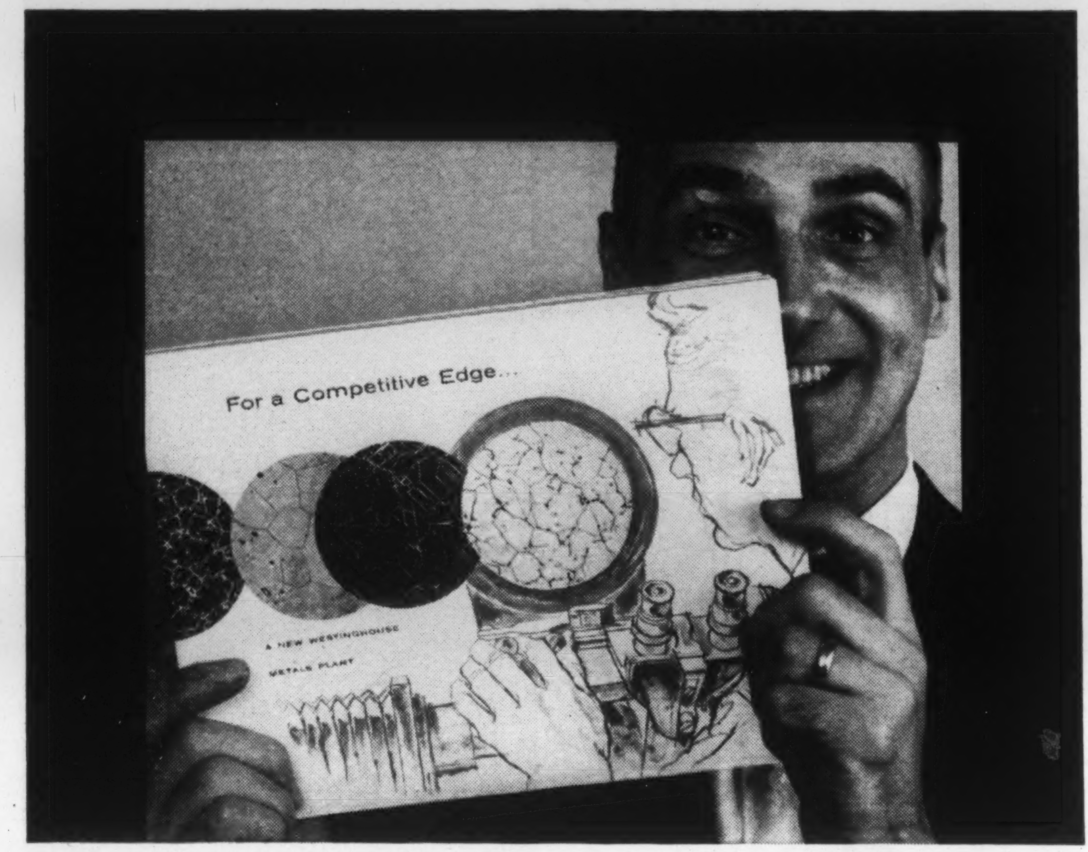


ALLOYS AND CASTINGS FOR A COMPETITIVE EDGE

FREE . . . send for your copy of the helpful new Westinghouse booklet, *For a Competitive Edge* (B-6570). It describes how you can keep up with metals advances in the face of increasing investment and rapidly expanding metals science.

The booklet takes you on a tour of the new Westinghouse metals plant at Blairsville, Pa. Pilot plant facilities here can help you explore full production conditions and create prototype quantities for wrought alloys and molded-metal products. Some production capacity can be made available for fast, dependable delivery of metal products.

Arrange to see the 16-mm, full-color, 22-minute Westinghouse film, *This New World of Metals*. Write Westinghouse Electric Corporation, Materials Manufacturing Department, Blairsville, Pennsylvania. J-05003

YOU CAN BE SURE...IF IT'S
Westinghouse

For more information, turn to Reader Service Card, Circle No. 438

Committee for Aeronautics, results of tests show that:

1. An increase in the amount of ductile metal binder in a cermet increases impact resistance.
2. The effect of binder composition on impact resistance may be either beneficial or detrimental. In one case, the addition of molybdenum to a nickel binder resulted in improved wettability of the carbide, producing a finer particle size and improved impact resistance. In another, a 46 nickel-2 aluminum-2% molybdenum binder was compared with a 32.8 nickel-12.7 molybdenum-3.5% aluminum binder, and it was observed that increased alloying of the nickel binder resulted in a decrease in impact strength.
3. Impact resistance continually decreases over the entire range of notch radii from 0.311 to 0.031 in. The stress concentration effect of the notch is less severe at higher temperatures.
4. The most impact resistant cermets tested, TC-66-I and JR-6, compare favorably with certain experimental alloys of very limited ductility.

Epoxy Potting Resins

A series of low cost, flexible epoxy resins has been developed by Houghton Laboratories, Inc., 322 Bush St., Olean, N. Y., for use in encapsulating electronic parts and for potting coils, connector plugs, transformers and submersible assemblies.

Called the Hysol 6900 Series, the compounds are said to com-

PROPERTIES OF HYSOL EPOXY RESIN

Tensile Strength, psi[a]	1700
Elongation, %[a]	113
Linear Shrinkage, in./in.[a]	0.010
Shore D Hardness[a]	70
Izod Impact Strength, ft lb/in.	4
Water Absorption (24 hr), %	0.43
Dielectric Constant (1 mc)	2.92
Power Factor (1 mc)	0.0279
Volume Resistivity (266 F), ohm-cm	9.6×10^{6}

[a] Cured at 167 F.

AVOID the **HIGH COST** and difficulty of fabricating long, hard & straight parts by conventional methods . . .

THOMSON 60 Case

hardened and ground

SHAFTS, ROLLS, GUIDE RODS and other long-round parts

60 Case is the result of over ten years of experimental work and production experience with hardened and ground shafts which are a requirement for BALL BUSHINGS, the Linear Ball Bearing manufactured by Thomson Industries, Inc.

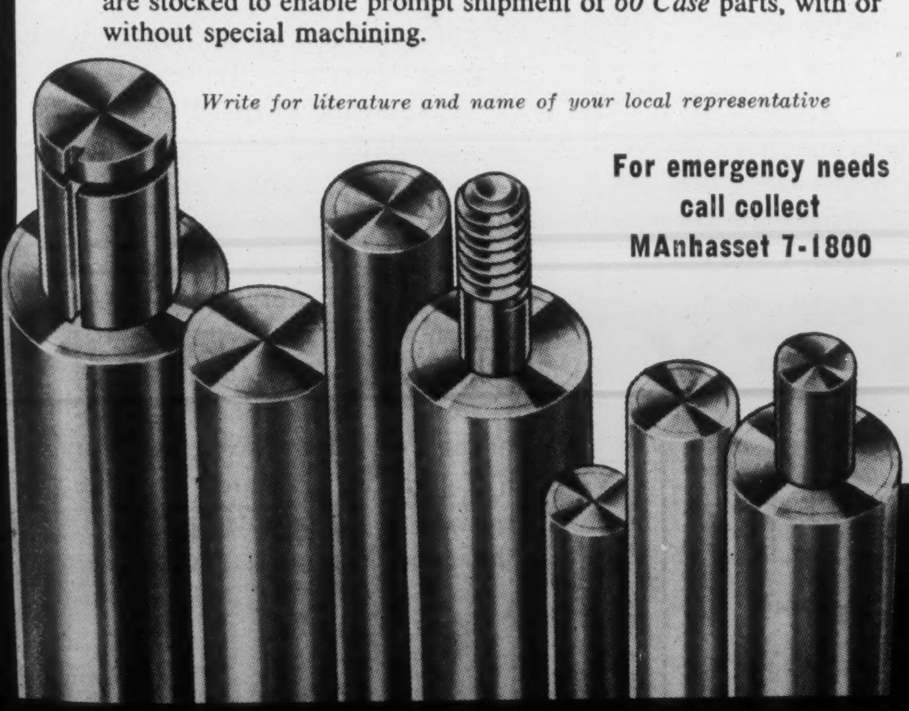
The special techniques and equipment that have been developed enable high production rates and low handling costs. This permits big savings over conventional methods which are plagued with erratic warpage, straightening and resultant grinding problems. Finished *60 Case* parts frequently cost less than the scrap losses that result from conventional methods.

60 Case material has a surface hardness close to 60 on the Rockwell C scale which is essential to resist wear.

Long lengths of material ranging in diameter from ¼″ to 4″ are stocked to enable prompt shipment of *60 Case* parts, with or without special machining.

Write for literature and name of your local representative

For emergency needs call collect MAnhasset 7-1800



ADVANTAGES of 60 Case

- COST REDUCTION
- HARD BEARING SURFACE
- ACCURATE DIAMETERS
- GROUND FINISH
- STRAIGHT PARTS
- DELIVERY FROM STOCK
- ADDED STRENGTH
- UNIFORM HIGH QUALITY

TYPICAL 60 Case PARTS

GUIDE RODS, SHAFTING, ROLLS, TRAVERSE RAILS, PISTON RODS, ARBORS, LEADER PINS, TIE RODS, KING PINS, AXLES, CONTROL RODS, GUIDE POSTS, MANDRELS, BEARING ROLLERS, SPINDLES

THOMSON INDUSTRIES, Inc.
Dept. C7, Manhasset, New York

For more information, Circle No. 416

Important! Specify TEFLON® by its properties!

TEFLON *can* provide extraordinary physical, electrical, and chemical properties, but these properties *cannot* be taken for granted.

The method used to convert Teflon powder into finished rods, sheets, and tubes greatly affects the quality obtained. This quality, in turn, governs the properties of the end product.

So to *assure* performance, actually specify not only Teflon but also the important *properties* required.

Two grades of Fluoroflex®-T deliver the *optimum* properties you specify for Teflon.

(1) "Electrical grade" Fluoroflex-T is certified to conform to all important electrical and physical properties. It meets the most critical requirements.

(2) A more economical "mechanical grade" satisfies all chemical and thermal needs and offers up to 50% greater resistance to elongation under mechanical loads.

Both grades are produced under exacting quality control standards and are stress relieved to insure that machined parts are dimensionally stable.

Send for data or better still tell us what specific properties are important for your application.

® Teflon is a DuPont trademark. Fluoroflex is a Resistoflex trademark.

RESISTOFLEX

CORPORATION • Roseland, N.J. Western Plant: Burbank, Calif.
SOUTHWESTERN PLANT: DALLAS, TEX.

Warehousing Distributors: Western Fibrous Glass Products, Los Angeles, Calif.; F. B. Wright Co., Detroit, Mich.; Colonial Kolonite Co., Chicago, Ill.; Industrial Safety Supply Co., Hartford, Conn.; Lone Star Rubber Co., Houston, Tex.; Flow Products, Inc., Chicago, Ill.

For more information, turn to Reader Service Card, Circle No. 534

bine ease of handling with low heat cure and flexibility. According to the producer, both filled and unfilled versions are available with two degrees of flexibility for each type. Transformers encapsulated with the resins are said to have successfully passed military temperature cycling and thermal shock tests.

Coated Aluminum Coils Eliminate Finishing

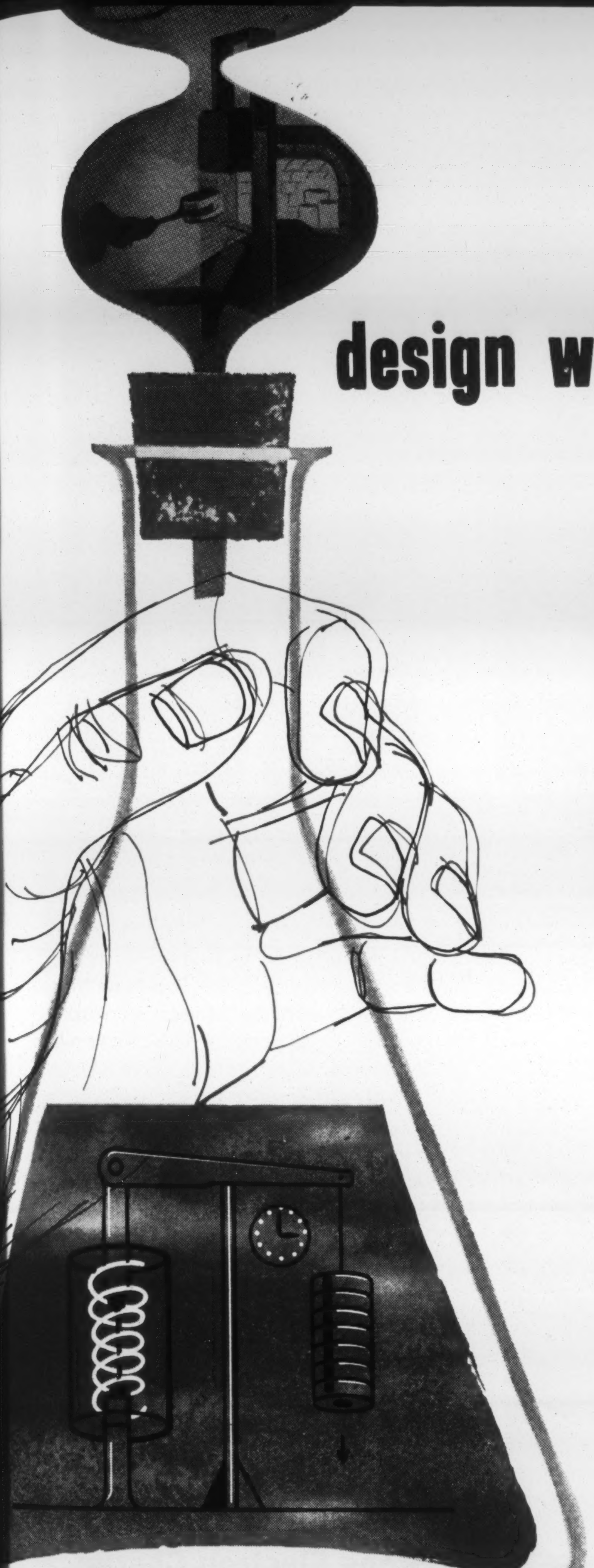
By using a pre-enameled, prefinished aluminum coil, aluminum products can be produced in a variety of organic colors directly from roll forming machines, press brakes, draw or punch presses.

Reynolds Metals Co. is the latest producer to enter this field. Called Colorweld, the material is supplied in widths from ½ to 36 in., in thicknesses from 0.016 to 0.051 in., and is available in a range of 20 colors. Because the enamel is securely bonded to the aluminum, the coils may be stamped, bent or formed.

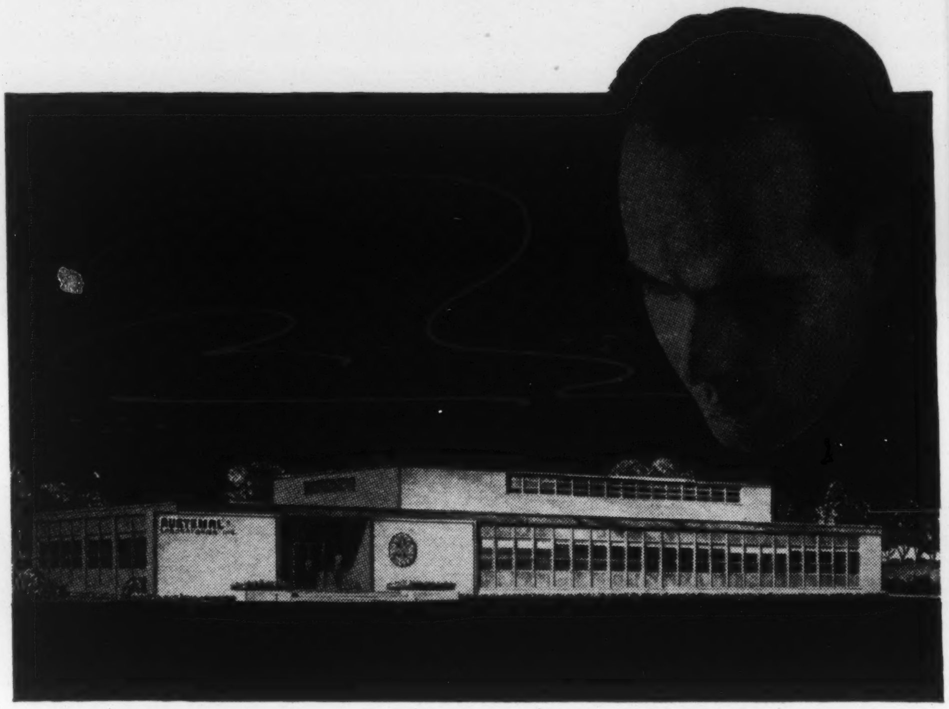
New Varnished Tape Bends Without Cracking

A new varnished polyester web tape is said to have excellent conformability properties when compared with other varnished tapes. Developed by Irvington Div., Minnesota Mining & Mfg. Co., 6 Argyle Terrace, Irvington 11, N. J., the tape is rated as a Class A insulation for generators, transformers, cables and electric motors.

According to the producer, the tape can be deformed without rupturing the varnished coating. This ability of the tape to deform without cracking is attributable to the nonwoven polyester fibers in felted form which run in a random pattern within the tape. The good wrapping properties of



design with austenal in mind



New **microcast** *Research Facilities will increase investment casting applications and give design engineers greater latitude in planning parts.*

A new facility for advanced research is now under construction at Austenal to broaden the many applications of Microcast—to make new methods and alloys available, and to allow greater freedom and latitude in part designing.

One section of this new plant will contain the equipment familiar to the investment casting industry and in addition, equipment necessary for investigating numerous other methods of making and treating castings. Adjoining the foundry area will be shops for pilot line and experimental work in mold making, waxing, investing and finishing. There will be an area containing laboratories for mechanical testing, physical testing, metallographic investigations, refractories development and chemical investigations.

Contact your Austenal engineer today and ask him to show you how Austenal's continuing program of research and development will help you design greater performance and reliability into the investment castings you require.

For more information, turn to Reader Service Card, Circle No. 377

It's **NEW** *from Austenal*

"Design with Microcast in Mind," Austenal's new informative booklet, tells you how to get the greatest benefit from Microcast, showing the great latitude of design possibilities, alloys available and a great deal more, valuable information. Write for it today.

design
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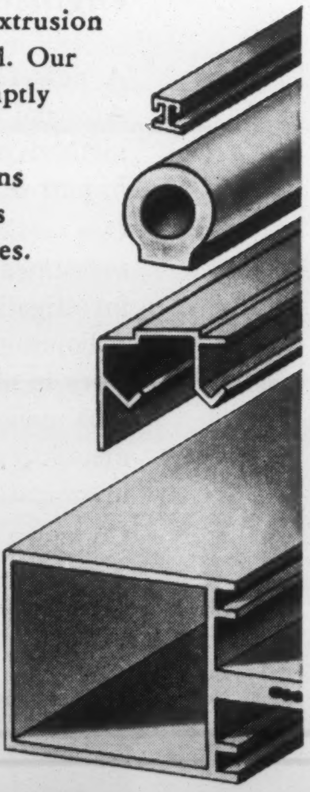


***Varnished polyester tape** conforms to hard-to-wrap units.*

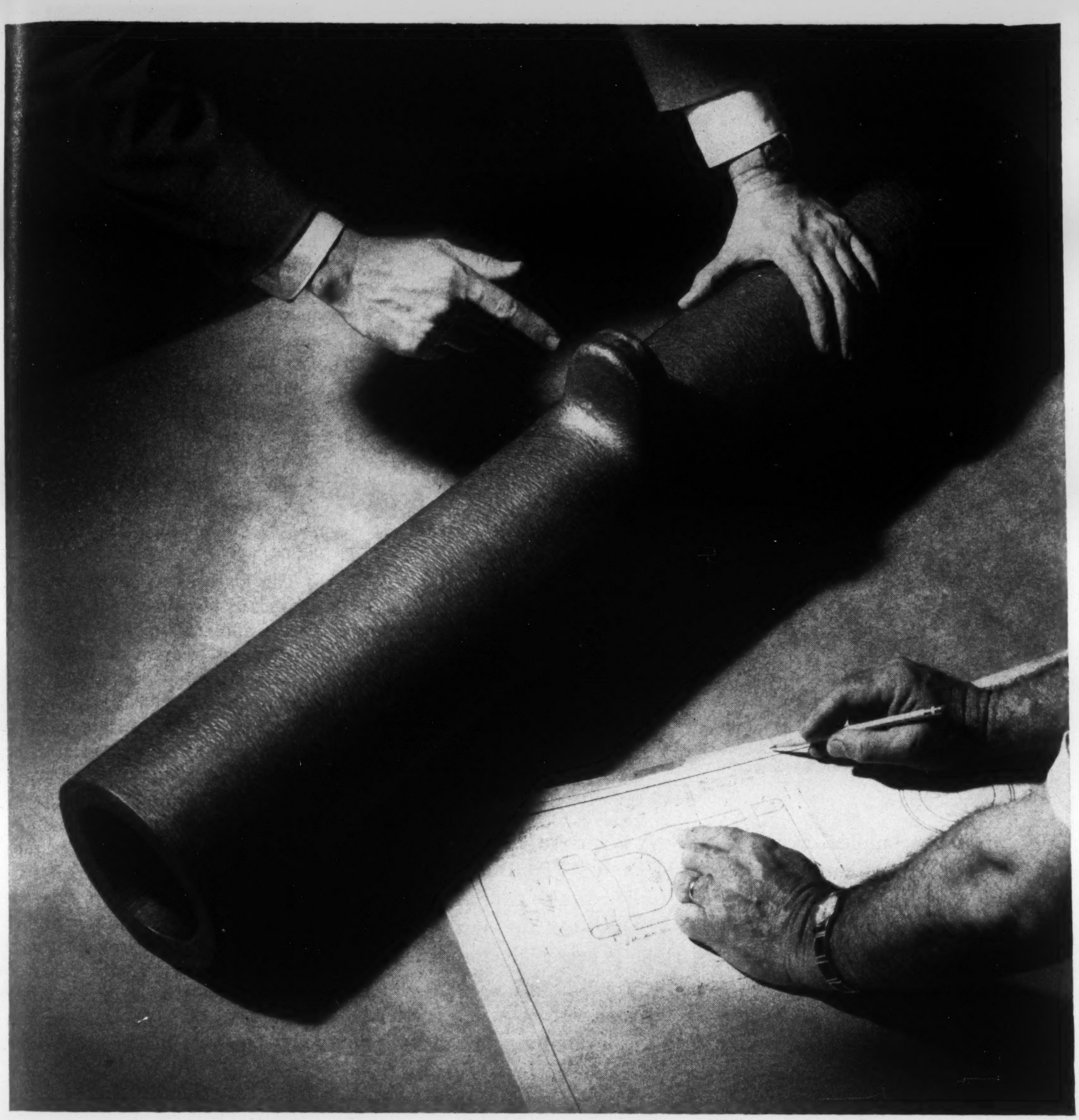
the tape are said to allow some manufacturers to increase the dielectric strength of their insulation by approximately one-third without increasing the over-all dimensions of the completed electrical unit.

Properties of the tape include a dielectric strength of 1650 v per mil, an elongation of 20%, water absorption of 0.5% after 24-hr immersion in water, and a power factor of 0.02. The tape is said to have good resistance to salt water, acids and alkalies.

It is available in 7 and 10-mil thicknesses in either black or yellow varnish. Widths range from 3/8 to 2 in. in 36-yd rolls.

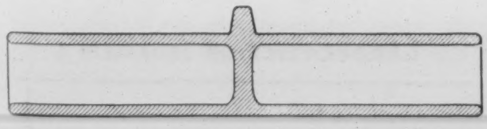
Tin Chloride Coating Stops Electron Charge

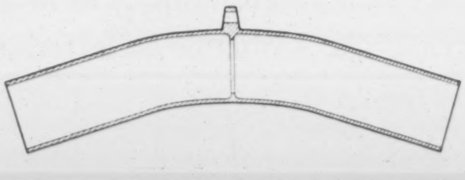
Platinum, gold, silver and graphite coatings are frequently used on the inner sides of electron tubes to prevent electrons from charging the glass. However, these coatings are hard to apply and for many applications they have the added disadvantage of being opaque. A stannic chloride coating, developed a few years ago at the Naval Research Laboratory,



THE CAMERON CURE FOR DESIGN DILEMMA

How would you produce this relatively simple component? Actually, it's not simple but Cameron had the cure. This actuator for the horizontal stabilizer of the North American F-100 Super Sabre is a cylinder with a thin solid center section and one central protrusion. Formerly it was a weldment — two sections of tube stock with a small forging in the center — right here is where the headache developed because a cold bending operation was required. Welds parted, rejects were too high. The Cameron split-die forging process changed all of this.





Now it is forged in one piece. Grain structure is excellent, final machining and cold bending are easy—rejects are low and design department spirits are up.

If you have a problem in a ferrous component (200 to 5000 lbs.), especially one for critical service, with internal curvatures and perhaps odd protrusions which cannot be forged in conventional dies, CALL ON CAMERON.

Our facilities are complete from melting of high quality alloy steels for our unique forging operations to final machining if desired. Many knotty design problems are finding a simple solution in the unusual shapes and quality controlled alloys coming from Cameron. Write or call . . .

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SPECIAL PRODUCTS DEPARTMENT
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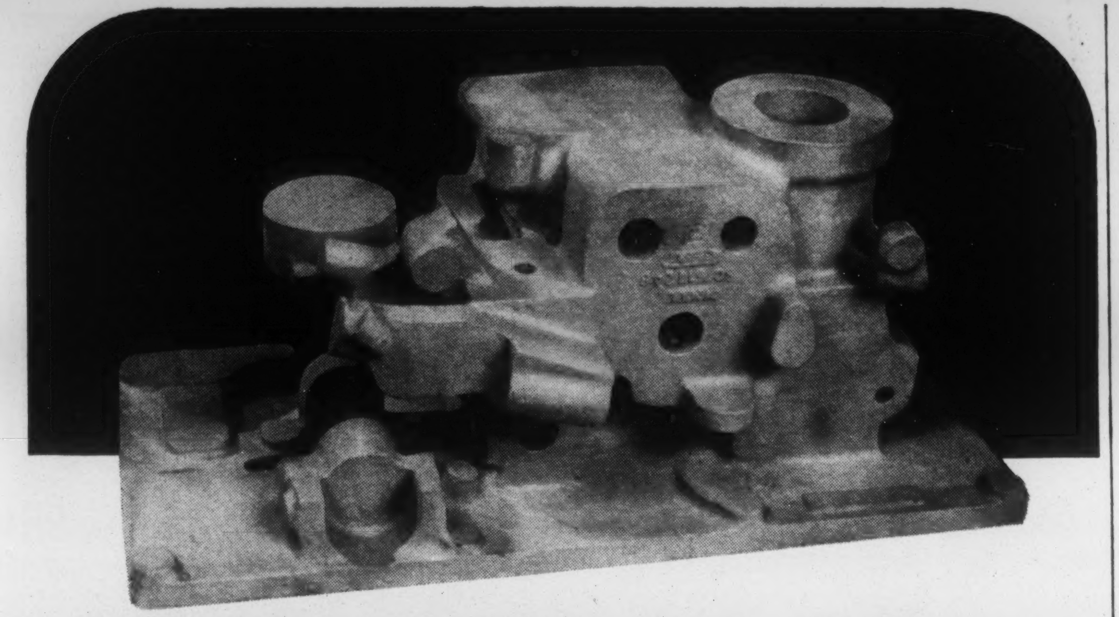
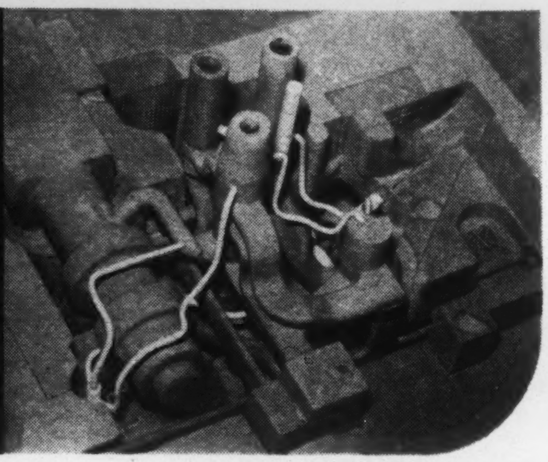


complex aluminum sand casting

for high
temperature
applications



intricate internal cored passages for above casting

This extremely complex aircraft valve body is currently being sand cast by Rolle in two aluminum alloys . . . 355T6 and 356T6. But as part of a continuing program of casting research, Rolle has also poured the piece with equal success in ZRE1 and A-142. While A-142 does not yet have the acceptance of many other alloys, Rolle is extremely interested in its possibilities in high temperature applications.

The valve body is an ideal test piece for such research. Few castings offer a tougher trial of as-cast properties. The many small diameter passages through the piece demand intricate tube coring as well as the more conventional sand cores. The tubes are removed after casting by a process developed in Rolle's Research Laboratory.

Whether your needs are limited to conventional alloys and casting techniques, or demand unique experience in high temperature alloys, intricate tube coring, etc., you'll find Rolle an ideal source of aluminum and magnesium sand, permanent mold, shell, and investment castings.

FREE 57-PAGE CASTING ENGINEERING HANDBOOK helps you design and specify aluminum and magnesium castings. Available on letterhead request. Write for your personal copy.

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seems to offer many advantages over platinum, gold, silver and graphite coatings. Application of the stannic chloride coating does not require vacuum exhaust or mixing chambers and requires less time than other coatings. The relatively quick and easy method of applying this conductive coating to electron tubes was discussed by W. W. Campbell of the Electron Tubes Branch of the Laboratory, in the Mar '57 issue of *NRL Progress Report.* The technique:

The glass electron tube is first heated to its annealing temperature while rotating in a lathe. A solution of stannic chloride (anhydrous fuming) and isopropyl alcohol is then sprayed onto the hot glass. The resulting coating is transparent and is said to be resistant to electron bombardment. A mixture of chromic oxide and glycerine can be painted on specified areas of the tube where coating is not desired. This mixture is said to have the advantage of withstanding higher temperatures than previous materials. It can be easily removed with water and a detergent after the stannic chloride coating has been applied.

Urethane Foams

A series of two-component polyether-based resins for producing urethane foams has been announced by Isocyanate Products, Inc., P. O. Box 1681, Wilmington 99, Del. Designated Isofoam L, the mixed formulations are said to produce low cost urethane foams that have low compression set, good aging and chemical re-

PROPERTIES OF ISOFOAM L

Density, lb/cu ft	3.0
Tensile Strength, psi	12.4
Elongation, %	120
Compression Set (22 hr at rm temp), %	6.7

STAINLESS

STEEL

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DIFFERENCE

...its effect on supersonic flight

Stainless steel construction in the world's largest supersonic wind tunnel permits the first satisfactory ground testing of full-scale turbojet and ramjet engines. Stainless steel was the choice for this job because of its strength, corrosion resistance and ability to retain a smooth surface.

The combination of strength and resistance to heat and corrosion in stainless steel is also making possible new ideas in plane construction and design.

For more facts about stainless steel and the contribution it can make to aircraft design, see your stainless steel supplier or write ELECTROMET—leading producer of more than 100 alloys for the metal industries, including chromium and manganese for making stainless steels. ELECTRO METALLURGICAL COMPANY, Division of Union Carbide Corporation, 30 E. 42nd Street, New York 17, N. Y. *In Canada:* Electro Metallurgical Company, Division of Union Carbide Canada Limited, Toronto.

In the world's largest supersonic wind tunnel at Lewis Flight Propulsion Laboratory, N. A. C. A., Cleveland, Ohio, huge stainless steel plates withstand wind velocities of 2300 mph—more than three times the speed of sound.

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...THANKS TO ALLOYS

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The terms "Electromet" and "Union Carbide" are trade-marks of Union Carbide Corporation.

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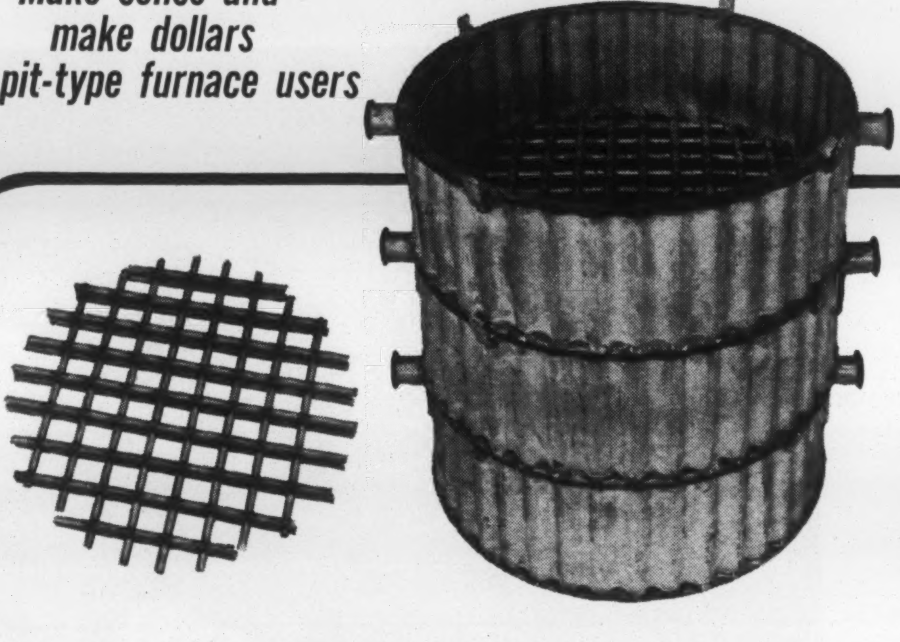
ROLOCK
FABRICATED ALLOYS
HEAT AND CORROSION RESISTANT

Make sense and make dollars for pit-type furnace users



ROLOCK'S unique CORRUGATED construction
with pressure-welded truss-type grids

There are many good reasons why these new furnace baskets out-perform and outlast older types. ROLOCK's Corrugated Construction gives high strength with light weight and this, in turn, means less material to bring up to temperature with faster, more uniform heat transfer . . . and a higher ratio of pay load to basket weight. Such baskets mean a substantial saving in furnace time because of faster recovery and, in some cases, an increase in average load as well.

ROLOCK's specialized Welded Fabrication takes full advantage of this construction in every respect. The grid, for example, is built up from rounds rather than flats by a ROLOCK-developed pressure-welding method. Experience shows that such grids are far better able to withstand thermal shock. They may be reversed as required, to compensate for deflection, without cracking.

In this field, as in many other specialized applications of welded-fabricated heat-resistant alloys, ROLOCK's exceptional facilities and skills often promise major operating savings. Write us outlining your problems.

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JOB-ENGINEERED for better work
Easier Operation, Lower Cost

6RL57

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sistance, and high resilience. According to the producer, the shelf life of unopened containers of Isofoam L is at least three months when storage temperatures do not exceed 100 F.

Wax in Polyethylene Raises Melting Point

The melt index of high and low density polyethylenes is said to be increased considerably when blended with a new synthetic wax called Paraflint. For instance, a 10% blend of the synthetic wax with low density polyethylene shows a melt index of 5.8 gm compared with a melt index of 1.98 gm for unblended low density polyethylene.

The higher melt index of the modified polyethylene is said to aid in the production of injection molded polyethylene products and to improve the appearance, stiffness and gloss of such polyethylene products as bath mats, toys, kitchen utensils and flexible pipes. Available from Moore & Munger Co., 33 Rector St., New York, the synthetic wax is a hard, high melting point (215 F) hydrocarbon wax. It is available at 15½¢ per lb in carload lots.

Adhesives for Bonding Metals, Nonmetallics

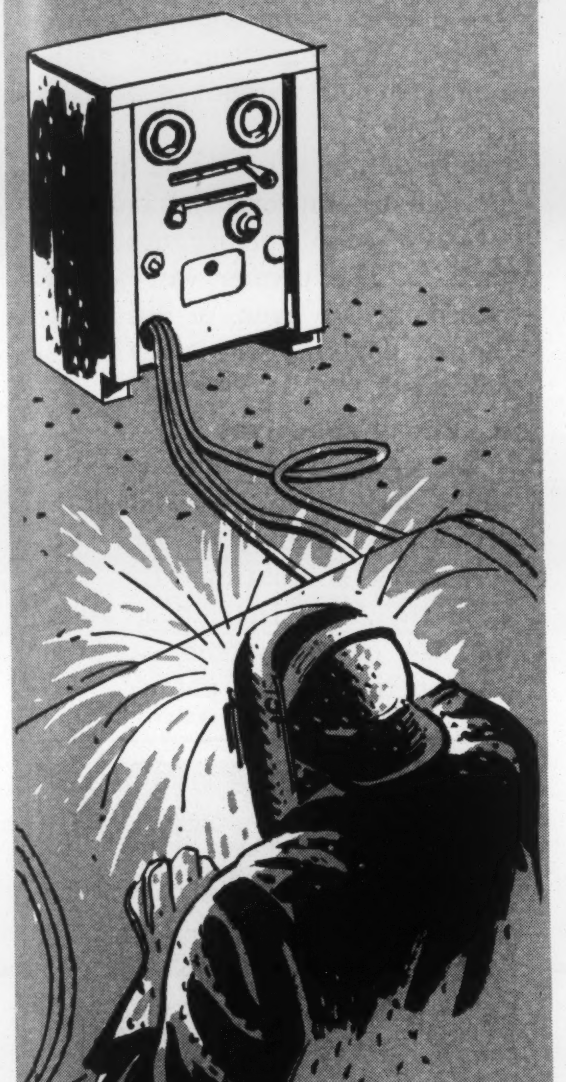
Recent developments in adhesives and bonding agents include an epoxy adhesive for bonding nylon to itself and other materials, three vinyl film adhesives, an epoxy adhesive for honeycomb sandwich construction and an adhesive for rubber-to-metal bonding.

1. Adhesives for plastics

Two new adhesives have been developed by Compo Chemical Co., 125 Roberts Rd., Waltham 54, Mass., for bonding plastics to

Welding Progress

at METAL & THERMIT CORPORATION • General Offices: Rahway, N. J.



NEW CONTROLLED ARC POWER SUPPLY IMPROVES WELDING

Teamed with constant speed wire feed, C.A.P.S. unit offers many advantages for semi and automatic welding.

A new constant voltage power supply recently introduced by the Metal & Thermit Corporation eliminates variables thereby lowering costs and improving weld quality. This rectifier-type machine delivers DC welding current at constant preset voltages. When teamed with a constant speed wire feed, it automatically controls the arc, maintaining a constant arc length. A built-in Arc Characteristic Controller provides a "cushion" effect, particularly desirable in low current density welding, and permits a greater range of current density with a given electrode. The result is lower costs, higher quality weldments.

C.A.P.S. welders have an efficiency of 85% or better and a power factor of 90% or higher at all settings. The equipment is rated at 100% duty cycle. Lighter and easily installed input wiring and switching are possible since less input current is required than in conventional power sources. Installation and power costs are both appreciably lower.

Literature on the M&T Controlled Arc Power Supply may be obtained by writing Metal & Thermit Corporation, Rahway, N. J.

Low hydrogen coatings improve hard surfacing electrodes

A new and different approach has been made to improve the quality and wearing characteristics of hard facing overlays. Low hydrogen coatings adapted to Metal & Thermit's HARDEX line enable these electrodes to deposit a weld metal of far less porosity and greater freedom from cracking. Penetration into the base metal and dilution by the base metal are at a minimum.

The wide line of HARDEX electrodes enables the welding engineer to select the *one* electrode which provides the best wearing quality at the least cost per pound of metal deposited. An M&T catalog, HS-56, is available through any M&T representative to simplify the selection of the right HARDEX electrode for any one of hundreds of applications.

New chrome-moly electrodes approved

For years one of the nation's foremost producers of power piping and high pressure boilers has been using a specially developed chrome-moly electrode on high pressure — high temperature service equipment. Its outstanding stress-rupture characteristics, high ductility over a wide range of temperatures, and economic advantage over other electrodes has proven the answer to safe, crack-free welds wherever high pressure—high temperature service is required.

Since these electrodes were first introduced by Metal & Thermit under the name Murex® CROLOY, more than half of the country's top petroleum refineries have approved their use for fabricating critical service equipment used in high pressure, high temperature operations. Welding engineers in other industries, too, are finding more and more use for CROLOY on other difficult-to-weld steels. A folder on M&T CROLOY electrodes and how to use them may be obtained through any Metal & Thermit representative.

WELDING SUPPLIES
PLATING MATERIALS • ORGANIC COATINGS
CERAMIC MATERIALS • TIN & TIN CHEMICALS
METALS & ALLOYS • HEAVY MELTING SCRAP

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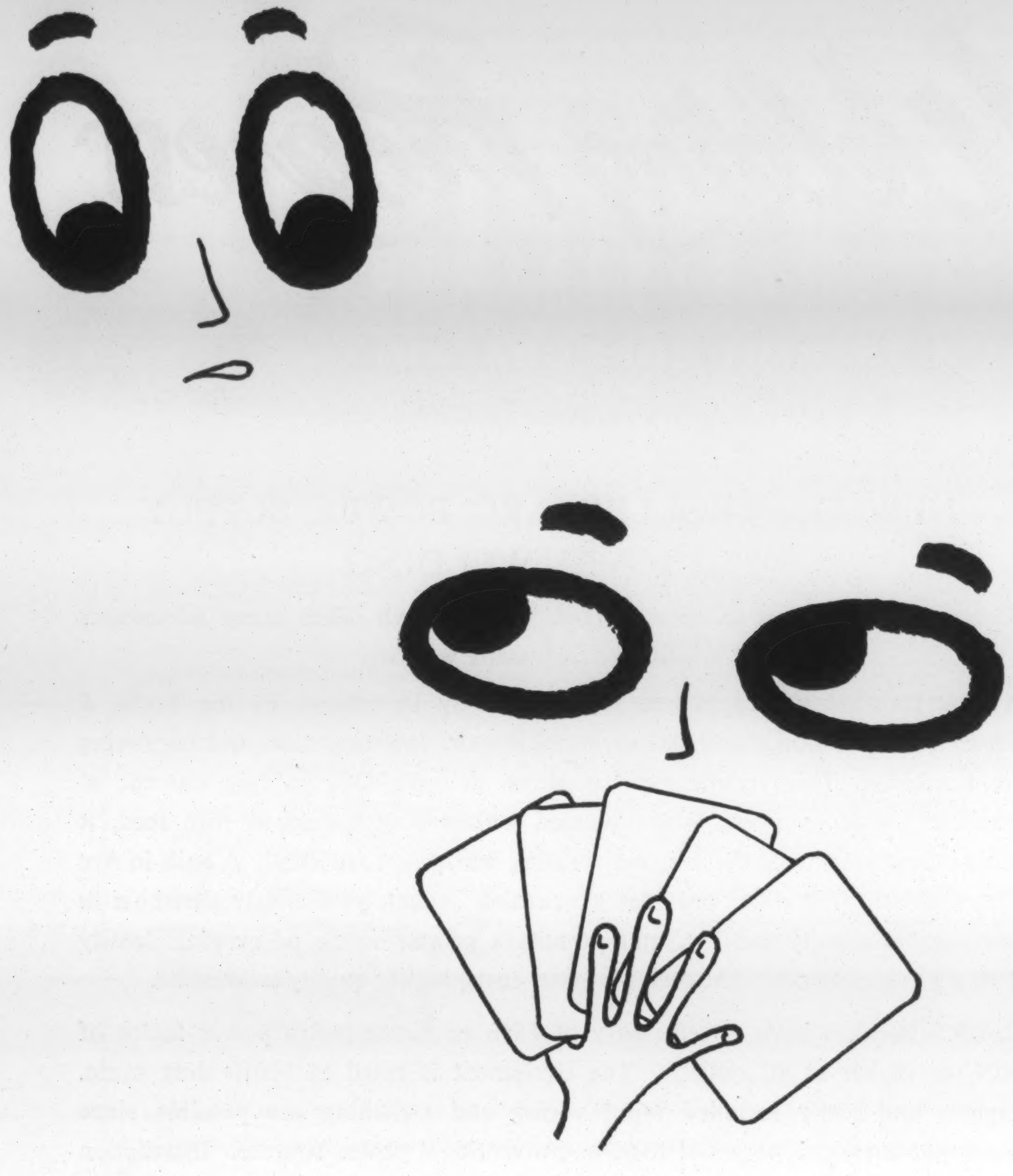

You're welcome to our technical service

Here's a word of advice, just in case you run into a problem in metal selection, fabrication or machining . . . or are faced with unusual service conditions or product requirements. You can get help from Riverside-Alloy's Technical Service Dept. Their wide experience with non-ferrous alloys through the years is at your service. Expert technical service is a Riverside-Alloy extra that stands behind our line of phosphor bronze, nickel silver, cupro-nickel, beryllium copper, stainless steel and nickel alloys. For information on our quality wire, rod and strip for your products, write to Riverside-Alloy Metal Division, H. K. Porter Company, Inc., Riverside, N. J.

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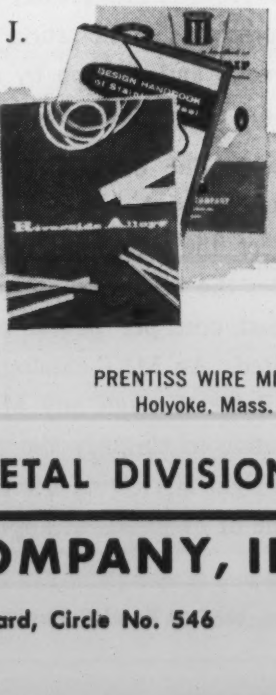

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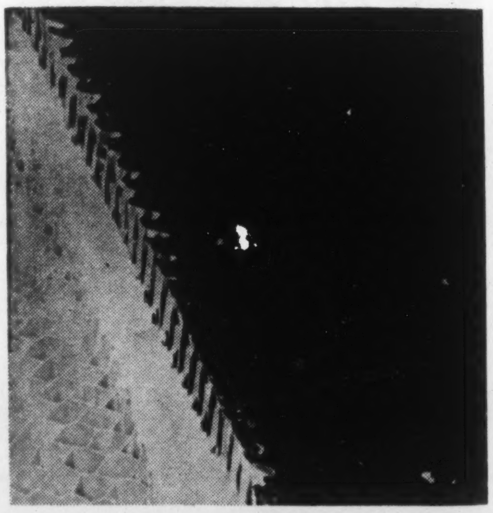
metals. One, a cement, is recommended for bonding semirigid vinyl to metal and other materials. According to the producer, the adhesive bonds so well that the plastics-metal laminate can be deep drawn, punched, cut, drilled and crimped without separating the bond.

The other adhesive, a primer, is said to improve the bond between plastisols or organosols and metals. The primer can be prebaked in an oven or air dried before applying the plastisol or organosol.

2. Epoxy adhesives

An epoxy resin adhesive, EC-1469, has been introduced by Minnesota Mining & Mfg. Co., Adhesives & Coatings Div., 423 Piquette Ave., Detroit 2, Mich., for use in honeycomb sandwich constructions (see photo). The adhesive is easy to apply, contains very little of volatile solvents, and is said to produce a solid bond between the honeycomb core and the plate. The adhesive is said to hold its bond at temperatures from –65 to 300 F. When cured without a catalyst it passes requirements of MIL–A–5090B. It is said to have good resistance to water and salt spray and can be



***Bonded honeycomb** structure (right) shows self-filleting properties of 3M's epoxy resin adhesive compared with uncoated honeycomb core (left).*

For more information, Circle No. 572 ➤

cured with or without the addition of a catalyst.

Carl H. Biggs Co., 2255 Barry Ave., West Los Angeles, Calif., has introduced Bonding Agent R-323, an epoxy-base compound for bonding nylon to itself, to metal and to other materials.

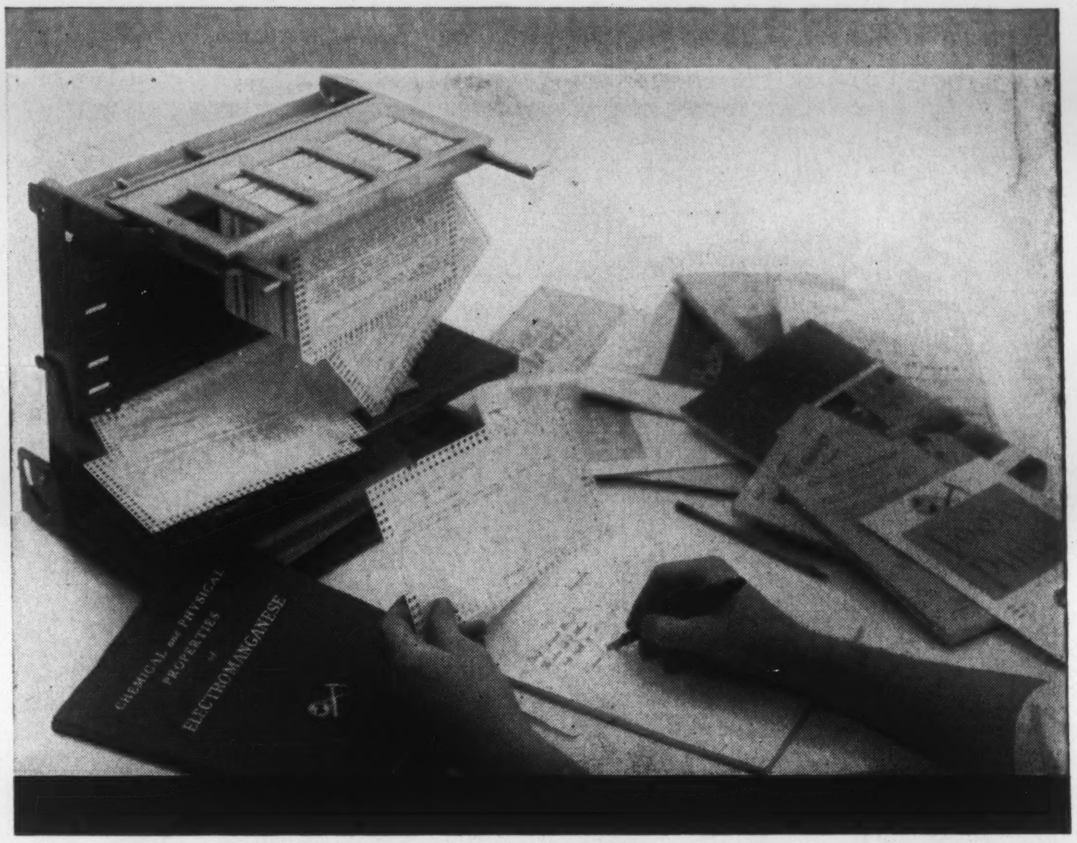
A complete line of industrial epoxy cements, adhesives and sealants, known as the Eccobond series, has been introduced by Emerson & Cuming, Inc., 869 Washington St., Canton, Mass. Included in the list of new adhesives are one-part and low viscosity types, and pastes and powders. One material is flexible at low temperatures and another is usable at temperatures up to 600 F. All the epoxy materials are said to have good electrical properties under severe environmental conditions.

3. Adhesives for rubber

Adhesive Products Corp., 1660 Boone Ave., New York 60, N. Y., has developed a synthetic solvent-based adhesive, called No. 3882 Adweld, for use on leather, plastics, metal, and natural and synthetic rubber surfaces. According to the producer, it is a one-part cement that does not require heat, catalysts or accelerators to cure it. The adhesive is said to provide a flexible, shock resistant bond that is impervious to most acids, oils, alkalies and heat and cold.

Lord Mfg. Co., Special Products Div., 1635 W. 12th St., Erie, Pa., has developed Chemlok 220 Adhesive and Chemlok 201 Primer for rubber to metal bonding. The adhesive and primer are recommended for bonding uncured natural and synthetic rubber to ferrous and nonferrous metals with a one-coat application. One coat of the new adhesive is said to produce a bond of greater strength than that obtained with conventional two-coat adhesives. A bond obtained by using the Chemlok primer and adhesive is

new . . . booming . . . stainless steels call for alloy help



and ELECTROMANGANESE® has it

New, high-manganese stainless steels are catching on fast. Their lower costs and better mechanical properties are just one reason. Producers and fabricators of the old high-nickel 300 Series alloys, now able to minimize the effects of nickel shortages, are switching to the new 200 Series. Others who have long looked with interest at stainless, but were discouraged by possible shortages, are adding to the growth.

If you are a steel producer, when you pursue the new stainless steels you'll need more manganese. You'll call for the purest manganese made . . . electrolytic manganese . . . because it's the cheapest way to get the necessary manganese content without harmful impurities.

The Electromanganese Division of the Foote Mineral Company is ready to help you get started. Since its development of 99.98% pure manganese on a commercial basis some 17 years ago, when people said it couldn't be done, it has built its reputation upon service. A letter from you will bring the technical knowledge resulting from this experience to your desk through a Foote engineer. Or, if you'd prefer more information first, you'll receive it promptly by writing our Technical Literature Department, Foote Mineral Company, 408 Eighteen West Chelten Building, Philadelphia 44, Pa.

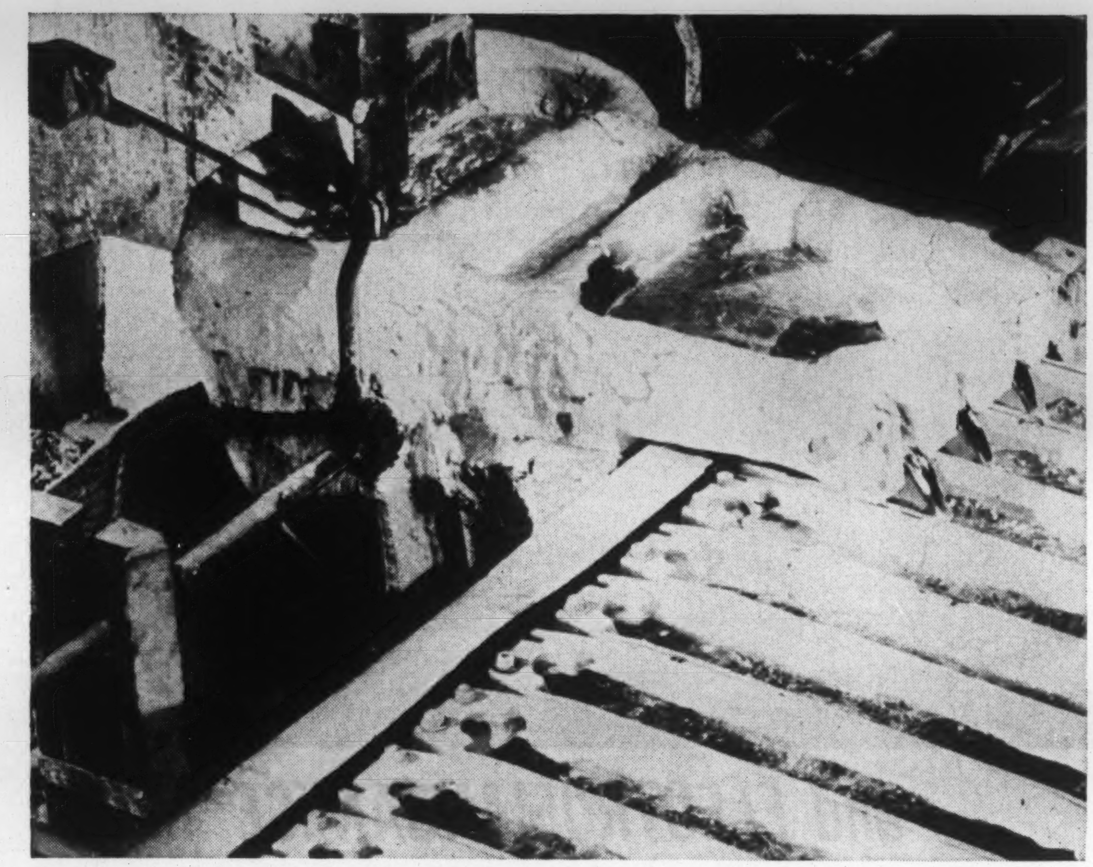
Foote MINERAL COMPANY

SALES OFFICE: *Electromanganese Division, Knoxville, Tennessee*
RESEARCH LABORATORIES: *Berwyn, Pennsylvania*
PLANTS: *Cold River, N. H.; Exton, Pa.; Kings Mountain, N. C.; Knoxville, Tenn.; Sunbright, Va.*

ELECTROLYTIC MANGANESE METAL • WELDING GRADE FERRO ALLOYS • STEEL ADDITIVES • COMMERCIAL MINERALS AND OXIDES • ZIRCONIUM & TITANIUM (IODIDE PROCESS) • LITHIUM METAL CHEMICALS AND MINERALS • STRONTIUM CHEMICALS

For more information, turn to Reader Service Card, Circle No. 483

Federated Aluminum Alloys always conform to published Performance Specifications



If you have had reason to doubt the performance capacity of certain aluminum alloys, it will pay you to consult Federated before you re-design or substitute another metal.

Often the performance requirements of a part indicate that a certain aluminum alloy will do the job; yet in operation, the part fails. Costly re-design or a more expensive metal are usually relied upon to rectify the trouble.

All aluminum alloys should provide the characteristics set for them in published specifications. At Federated's three aluminum plants, rigid quality control insures that production ingot adheres exactly to specified content. Impurities are held at or below the minimum allowable percentage.

Every heat of every Federated aluminum alloy is tested exhaustively. Refining, alloying and testing techniques are under strict quality-control procedures, developed by ASARCO's Central Research Laboratory, where scientists can control metal impurities to parts per million, if required.

A Federated field man will be around to see you soon. Spend some time with him. It will benefit you.

Federated Metals
ASARCO
Division of
AMERICAN SMELTING AND REFINING COMPANY
120 Broadway • New York 5, N.Y.
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For more information, turn to Reader Service Card, Circle No. 470

said to be resistant to wide temperature ranges, hot and cold water, salt spray, chemicals, solvents and corrosive atmospheres.

4. Thermocuring adhesive

A new thermocuring adhesive, designed especially for high temperature applications and known as Pliobond HT, has been introduced by Goodyear Tire & Rubber Co., Chemical Div., Akron, Ohio. The adhesive cures at approximately 350 F and does not creep under load at high temperatures. Tests show that cold rolled steel bonded with the thermocuring adhesive has no tendency to creep under constant load at 400 F. It is recommended for use in mechanical and electronic applications where resistance to high temperatures is required.

5. Adhesives for vinyl

Three water-base vinyl film adhesives are available from National Starch Products, Inc., Adhesives Div., 270 Madison Ave., New York, N. Y.

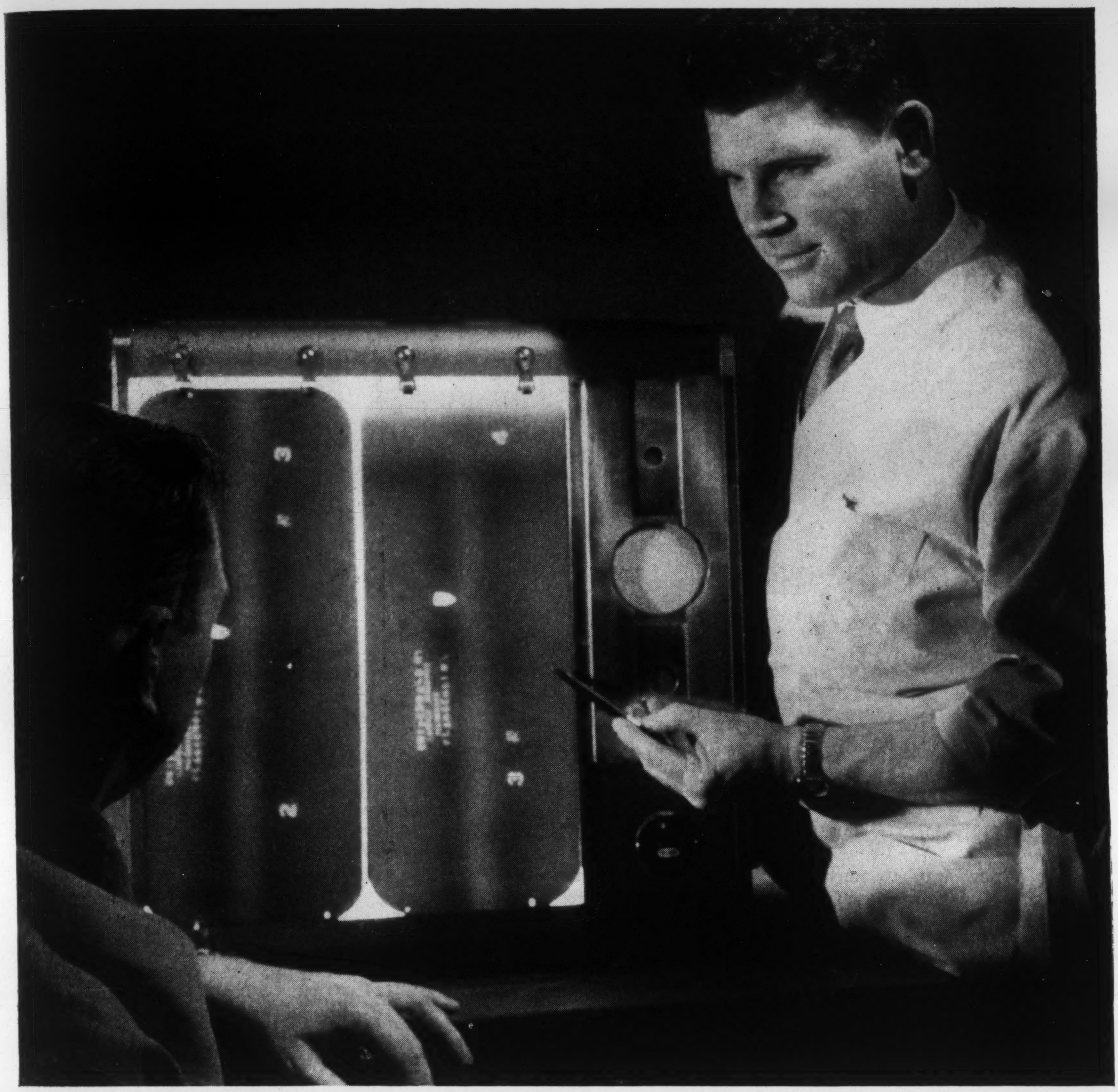
Resyn Emulsion 33-8020 is a general purpose adhesive for bonding vinyl film to cloth, paper and paperboard. It is a smooth, white fluid emulsion containing approximately 54% solids with a viscosity of 1000 to 1500 cps. Drying temperatures of 200 to 250 F are required.

Resyn Emulsion 33-8010, similar to Resyn 33-8020, has a viscosity of 5000 cps and is recommended for laminating vinyl film to latex saturated paper.

Resyn Emulsion 33-8030 contains a nonflammable solvent and is recommended for the wet combining of vinyl chloride films. It is a smooth, white fluid emulsion containing approximately 49% solids and has a viscosity of 1000 cps.

6. Hot melt adhesive

A new form of a hot melt adhesive has been announced by United Shoe Machinery Corp., In-



Get X-ray welds on alloy steels!

with P&H Low-Hydrogen electrodes

Here are electrodes that can keep you out of trouble on alloy steels.

P&H low-hydrogen electrodes give superior x-ray welds, with no porosity or cracking. Welds have exceptional strength and ductility through a wide temperature range, with as-welded properties comparable to stress-relieved.

Check P&H low-hydrogen rods for your really tough jobs — you'll find one to match the chemical or mechanical properties of any problem alloy you're handling. Write Dept. 316G, Harnischfeger Corp., Milwaukee 46, Wisconsin.

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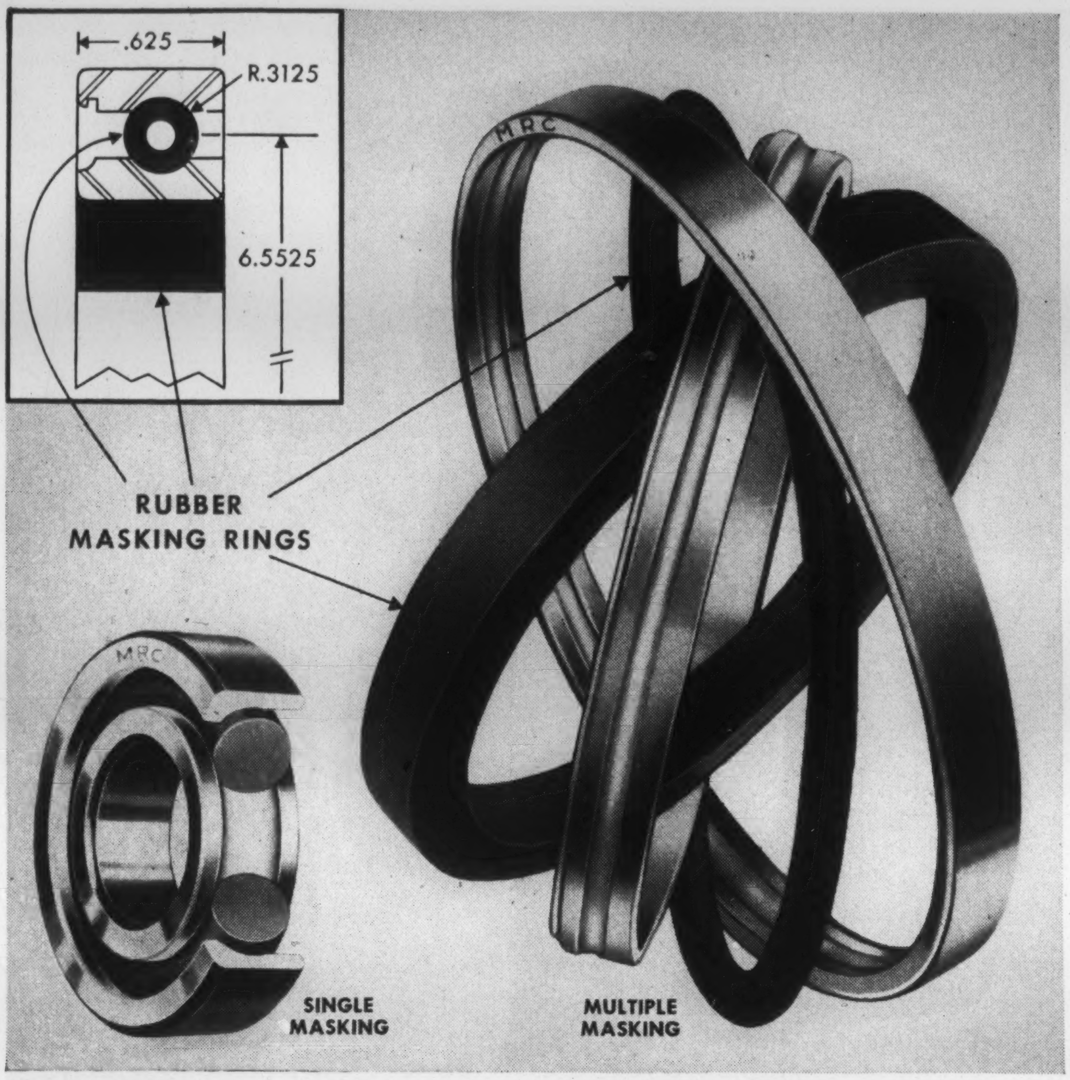

Photos courtesy Marlin-Rockwell Corp., Jamestown, N. Y.

Rubber Rings Mask Bearings during Plating Process

Here's a new way to mask out plating on bearing race grooves without tedious hand-labor. Regardless of bearing size, rubber rings are fitted precisely into ball grooves and inner ring bore so that plating can't sneak under the rubber even in torturous electroplating baths. Clean division lines always result. Inner ring and outer ring are held together so both can be plated simultaneously. This saves one complete plating cycle. And, this fast assembly prepares bearings for plating in seconds—eliminates costly hand-painting with unreliable stop-off lacquer.

These rubber rings are the result of Marlin-Rockwell Corporation (Jamestown, New York) consulting Continental to solve an important masking problem. Creative engineering successfully developed these extruded and spliced, or molded rubber rings which increased production 2000%—20 times faster than hand-painting. What's more, the special rubber compound withstands repeated baths in blistering acids and caustics without affecting precise dimensions, elasticity or resilience.

This rubber ring technique is typical of the thinking and ingenuity behind rubber parts by Continental. It also represents the economy and better end results accomplished by consulting a rubber specialist *during the planning stage* of a product. If you need help like this, call or write Continental —rubber specialists since 1903.

Engineering catalog.

In addition to custom-made parts, Continental offers an extensive line of standard grommets, bushings, bumpers, rings and extruded shapes. Hundreds of these are shown in the No. 100 Engineering Catalog. Send for a copy or refer to it in Sweet's Catalog for Product Designers.

Another achievement in **RUBBER**

CR *engineered by* **CONTINENTAL**

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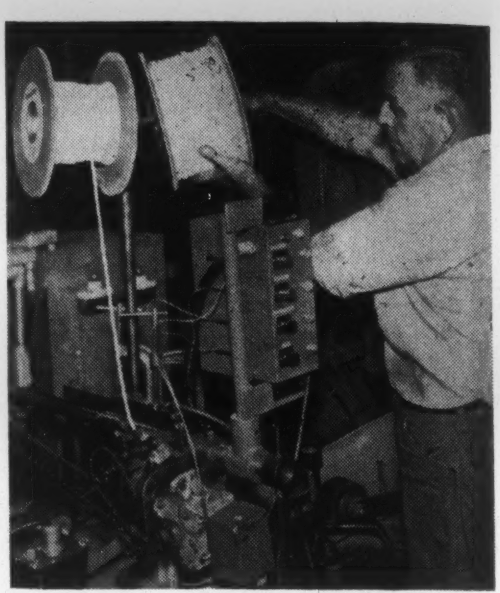


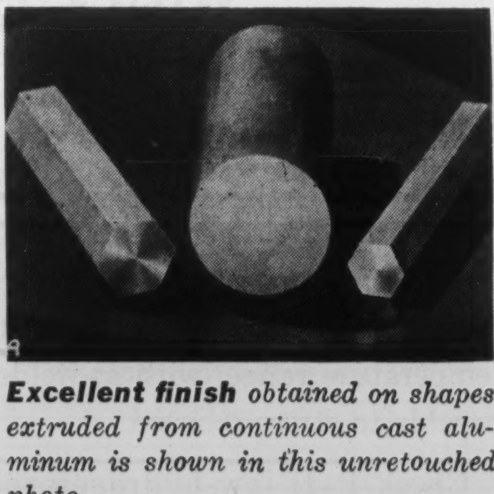
Coil form *of hot melt adhesive is said to speed bonding of polyethylene films, paperboard and paper.*

dustrial Sales Div., 140 Federal St., Boston 7, Mass. Called Thermogrip, the adhesive is supplied in coil form for use with special feeding and melting devices (see photo). Advantages claimed for the new form of hot melt adhesive are instant bond and ease of handling.

New Process Improves Continuous Cast Shapes

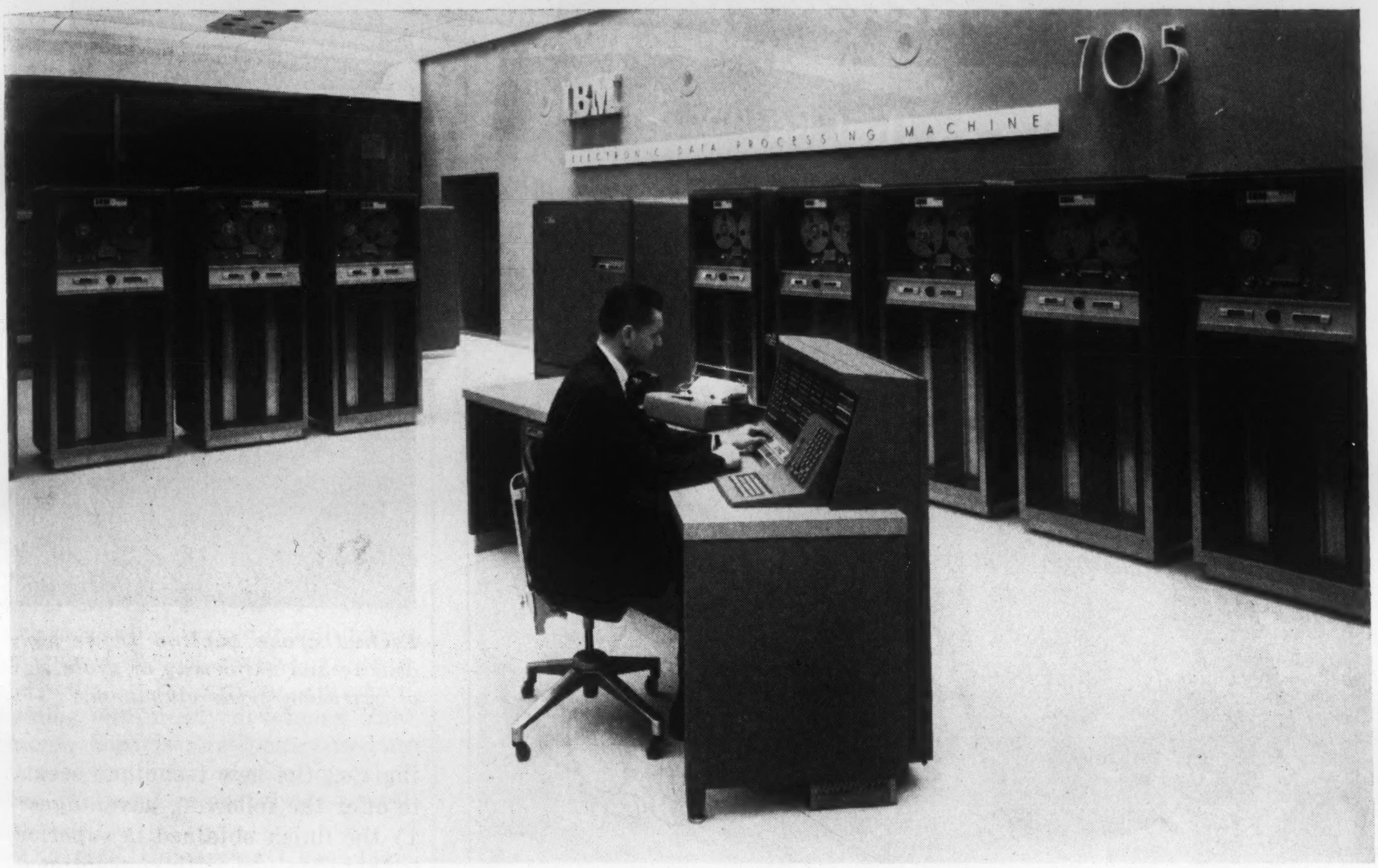
Continuous cast aluminum shapes with better properties than any previously available are said to result from the use of oil-lubricated graphite molds.

Known as the Apex-Goss Process and developed by Apex Smelt-

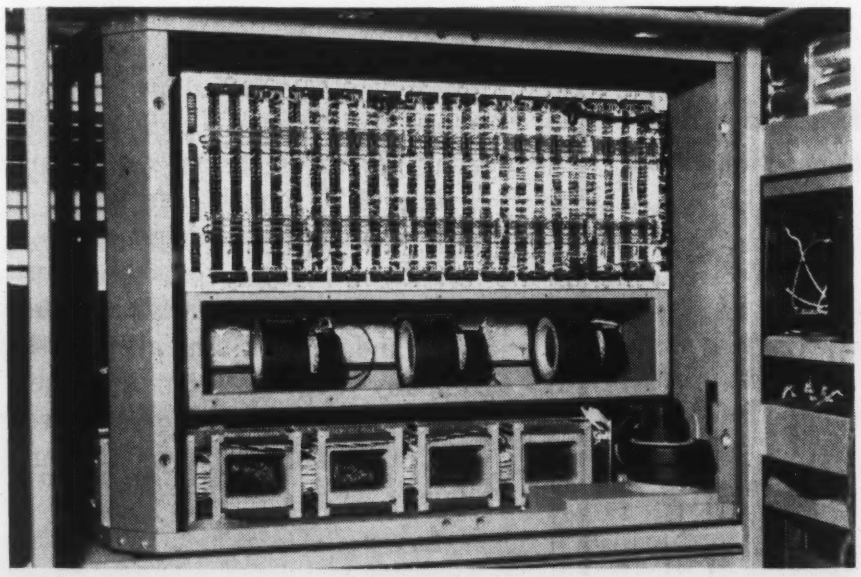


Excellent finish *obtained on shapes extruded from continuous cast aluminum is shown in this unretouched photo.*

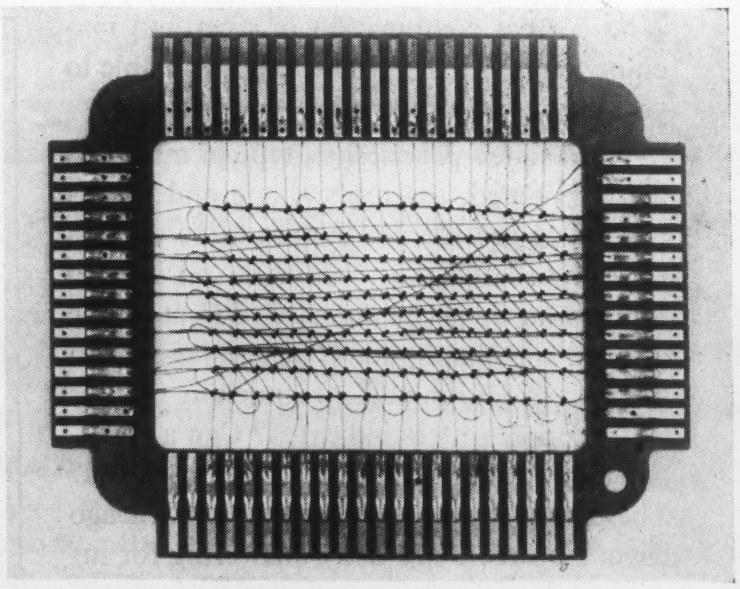
THE NATIONAL SCENE



KEEPING "ELECTRONIC BRAINS" FROM LOSS OF MEMORY. One of science's greater marvels is IBM's 705 Electronic Data Processing Machine—which makes intricate calculations and logical decisions in millionths of a second. Heart of this electronic "wizard" is its main magnetic core memory. Designed for use with the machine's high-speed printer is the IBM 760 Control and Storage Unit containing its own core memory of 1,000 positions which allows central processing to continue in the 705 while other data are being printed. Helping the 760 remember what information is to be printed is a job for PHENOLITE® Laminated Plastic. PHENOLITE's unique combination of properties makes it ideal for this application.



MOST ADVANCED FORM OF ELECTRONIC STORAGE. The 1,000-position core memory for the IBM 760 Control and Storage Unit—a portion of which is shown here—consists of pinhead size cores strung on copper-wired frames of PHENOLITE. Electrical impulses, passing through wires, alter the magnetic state of cores so that a group of them stands for a word or figure. Reversing the process recalls information from storage. PHENOLITE frames safeguard the circuit and permit stacking of core planes as shown.



PHENOLITE MEETS CRITICAL STANDARDS. Core frames like the one shown are punched out of laminated PHENOLITE by IBM. Each frame has printed circuit type terminal strips and soldered connections. PHENOLITE proves an ideal material for this application because it is mechanically strong and stiff, punches cleanly, etches well, remains flat, has high dielectric properties and withstands the heat of dip soldering.

NATIONAL CAN HELP YOU reduce unit product cost or improve product performance at no added cost. Here's why . . . You can select the "one best material" from over 100 grades of PHENOLITE, Vulcanized Fibre and National Nylon—without compromise in properties or cost. You can simplify production and purchasing with the timed delivery of 100% usable parts—from a single reliable source. You gain competitively with National's new materials and grades—the direct result of programmed materials-research.

You benefit by calling National first. Check Sweet's PD File 2b/Na, the Telephone Directory Yellow Pages, or write Wilmington 99, Delaware. Dept. KK6.

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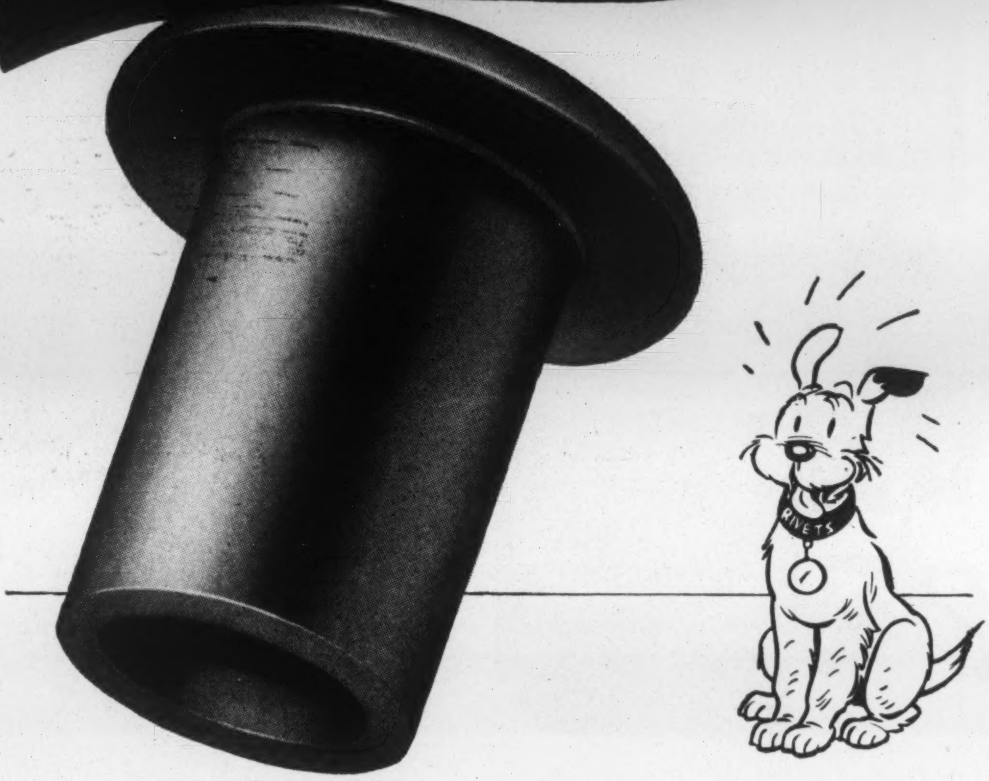
Back of a Chicago Rivet
Is an Organization That Really Serves



The RIGHT rivet, plus the RIGHT riveting machine will produce a fastened assembly at the RIGHT low cost

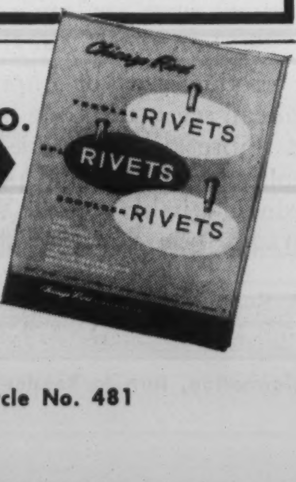
The correct combination of rivet and machine requires expert knowledge available to you through Chicago Rivet engineers.

Anticipated production, type of materials to be fastened, assembly shape and its expected service life are factors to be considered. Decisions must be made on a rivet metal or alloy. Type and size of rivet, shape of head and shank, depth of tubular section must be all determined. Are indexing fixtures and multiple setters indicated? Can a standard rather than a special rivet be used? These are the type of questions Chicago Rivet Engineers are daily answering for industry. Their recommendations are available to you without cost. We suggest you send a blueprint or sample assembly with your inquiry.

There are
Chicago Rivet
Machines that will set
1
2
3
4
5
6
Tubular or Split
Rivets At a Time

Chicago Rivet & MACHINE CO.
965 South 25th Avenue
Bellwood Ill. (Chicago Suburb)
Branch Factory: Tyrone, Pa.

FOR YOUR FILES
Rivet catalog describing 1388 standard tubular and split rivets and 26 single and multiple automatic rivet setters.



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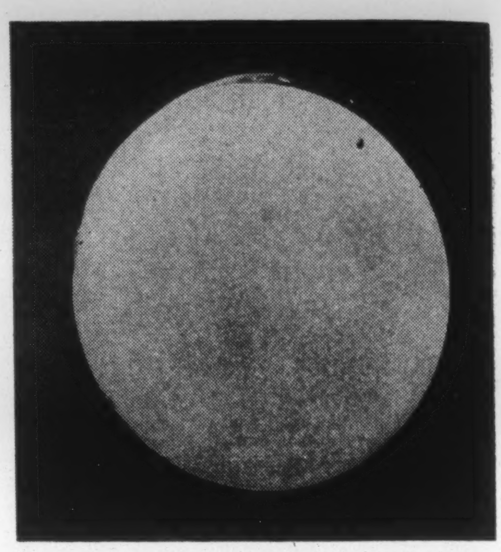


Etched cross section *shows high density and uniformity of grain size of extrusion grade aluminum.*

ing Co., the new technique seems to offer the following advantages: 1) the finish obtained is superior to that obtained with conventional casting; 2) exceptionally high casting speeds are possible; 3) all types of aluminum alloys can be cast; 4) any standard shape can be cast, including round, square, hexagonal, flat, etc.; 5) grain size can be accurately controlled and kept uniform; 6) small cross sections are easily cast; and 7) lengths can be cut to most economical dimensions.

Although most of the work done to date has been with aluminum and aluminum alloys, the company believes that the new process will work equally well with other nonferrous metals and alloys.

Nickel-Base Alloys for Turbine Blades

The current trend in jet engine design is to increase air flow and gas temperatures. Doing this, however, produces higher stresses and temperatures in the turbine blades, which are already operating near the limit of the strength of current blade alloys. One solution to this problem is to cool the blades to temperatures at which

UNICHROME
Trade Mark

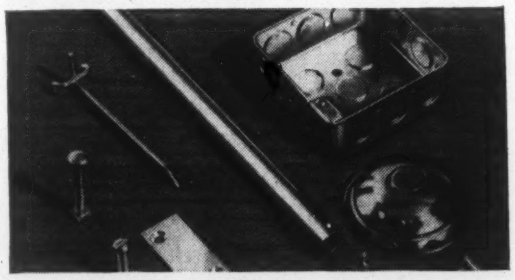
News about
COATINGS for METALS
Metallic.........Organic.........Decorative.........Protective

Plastisol gives metal products flexible armor against wear, corrosion

Chrome-like finishes produced at new low cost

For the first time, bright chrome-like finishes become economically practical for low cost zinc plated products such as electrical conduit and boxes, toy wheel goods, rough hardware and others. Economical chromate treating with newly developed Unichrome Dips is now being used to increase shelf life and sales appeal of even the most competitively priced products.

The new Unichrome Clear Dips operate at extreme dilutions. Make-up costs are low. So are operating costs, even where dragout of solution during production is a factor. Costs for dip compound range between 30¢ and 60¢ per 1000 sq. ft. of surface treated.



A unique feature of these Dips is their stability, which saves through long "mileage" from the solutions, and consistent results.

Write Metal & Thermit for recommendation on your specific application. Virtually any requirement in chromate finishing can be met from the wide line of Unichrome Dip Compounds.

Unichrome is a trademark of Metal & Thermit Corp.

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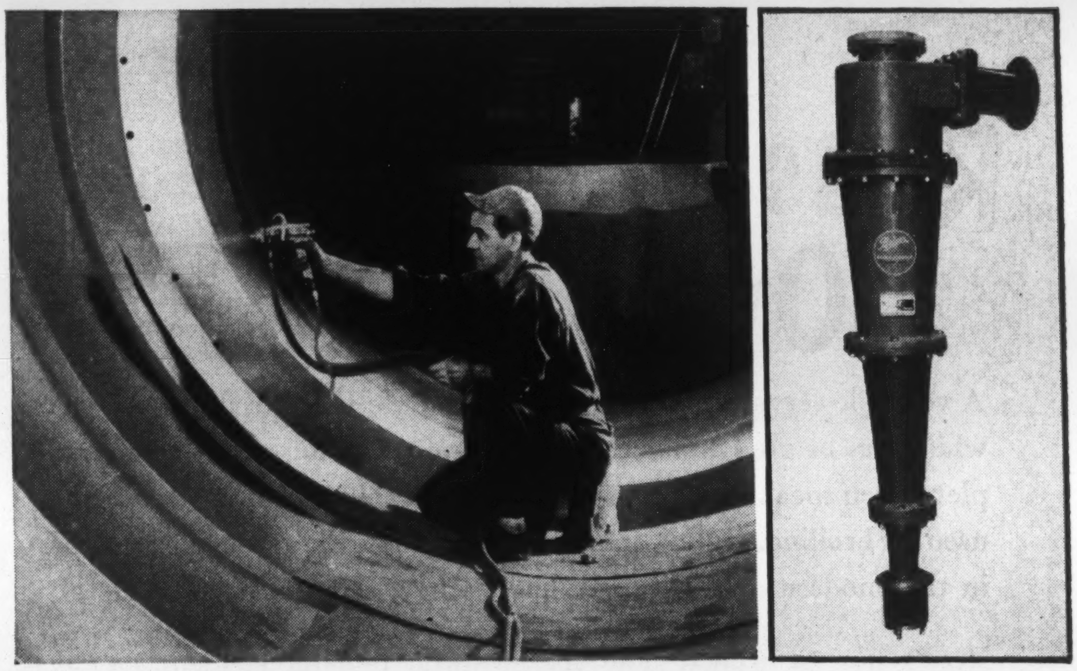


(Left) An example of the large work that can be protected, these metal cones for storage tanks are being sprayed by General Coating Co., Woodbridge, N.J., with "Super 5300" Plastisol for protection against abrasion and corrosion. **(Right)** Lined with Unichrome Plastisol, over 6000 of these centrifugal cleaners manufactured by Bauer Bros., Springfield, Ohio, are now defying wear and corrosion in paper mills.

Even ordinary metals protected with a coating of Unichrome Plastisol gain phenomenal ability to stand up in severe service. Engineers are finding in plastisols the means to improve product life, solve problems of wear and corrosion.

HEAVY DUTY MATERIALS

Sprayable Unichrome "Super 5300" Plastisol provides films up to 60 mils thick per coat. Unichrome "Series 4000" Plastisols form dipped coatings up to ¼-inch thick.

Unlike plastic sheet materials, plastisols conform to irregular shapes without air pockets or seams. The vinyl coating they form resists chemical solutions, fumes, moisture and other corrosives. Its pore-free thickness blocks permeation.

A Unichrome primer-plastisol system sticks tight, averaging a bond strength of 50 to 100 pounds per inch. It affords good flexibility to absorb mechanical abuse, resist abrasion to a remarkable degree.

SOME CASE HISTORIES

Liquid cyclones for removing dirt from pulp stock are subjected to abrasive, corrosive action of the stock. When made of stainless steel, bronze and chromium plated steel, they wore excessively. Lined with plastisol 4 years ago, these units have far exceeded life-expectancy of other materials.

Plastisol coated ducts exhausting strong acid fumes show no signs of deterioration after 4 years service.

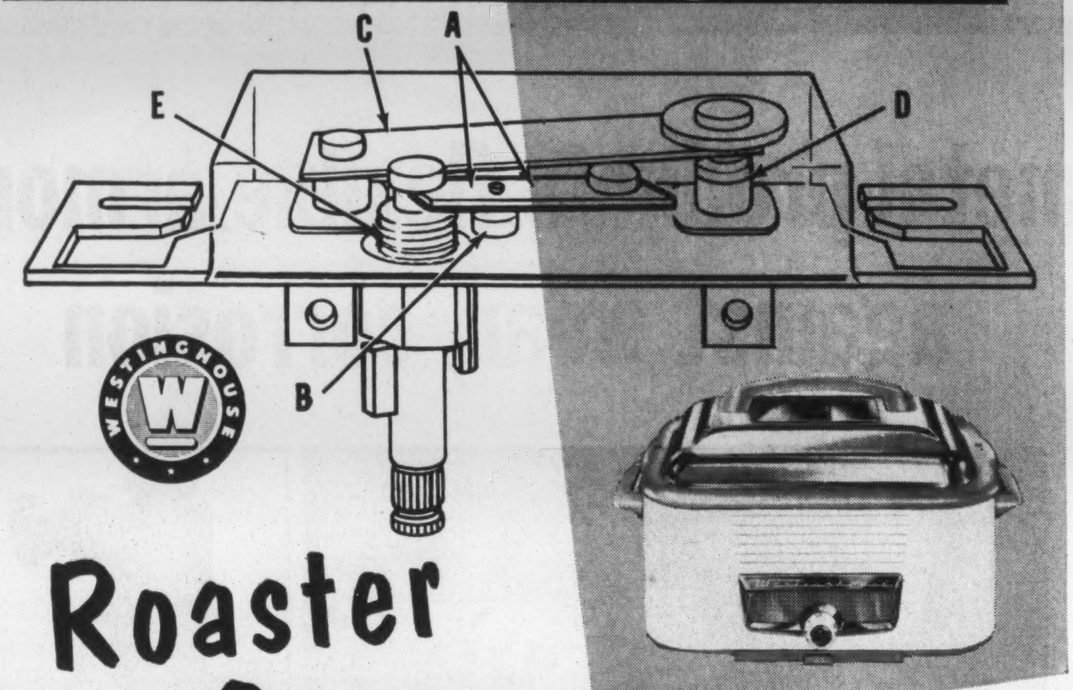
Lining sand-blast barrels with Unichrome Plastisol increased barrel life twelve times for one user.

After six months use, plastisol coated agitators for chemical mixers show absolutely no wear. Rubber coatings, used previously, started to fail after only one month.

Write for detailed bulletins on Unichrome Plastisols or the name of the nearest applicator.

For more information, turn to Reader Service Card, Circle No. 566

HOW CHACE THERMOSTATIC BIMETAL CONTROLS THE Westinghouse



Roaster Oven

A Product of
Westinghouse Electric Corp.
Mansfield, Ohio

A versatile servant is the new Westinghouse Electric Roaster-Oven which can be used to bake anything from a 14 lb. turkey to a complete oven meal. With its accessory, the broiler grid, it also can be used for broiling, grilling and frying. Of course, the actuating element in this modern appliance is reliable Chace Thermostatic Bimetal.

Here's how it works: The thermostatic bimetal element (A) is mounted freely on the fulcrum pin (B), in a position exposed to radiation from the roaster heating element. The current is carried by the leaf spring (C) through the contacts (D). As the ambient temperature in the roaster increases, the bimetal element (A) deflects in the direction of the spring (C), until the insulated tip presses against the spring and opens the contacts (D). The temperature then drops, the bimetal returns, the contacts meet and this cycle repeats. Since the notched end of the bimetal element is engaged in the groove in the threaded stem (E), turning the control knob clockwise moves the bimetal away from the spring, thus prolonging the contact time and raising the cooking range.

Remember Chace when you design for temperature actuation or indication, or for protection of valuable equipment. Dependable Chace Thermostatic Bimetal is available in 28 types, in strip, coil or completely fabricated and assembled elements made to your specification. Write for new 44-page booklet, "Successful Applications of Chace Thermostatic Bimetal," containing interesting uses of bimetal and many pages of engineering data.

IT BENDS WITH THE HEAT
W. M. CHACE CO.
Thermostatic Bimetal
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the material is stronger.

Some of the most promising designs of cooled turbine blades are actually shells made from sheet. Air is blown through the blades to lower the metal temperature to a value where its strength is sufficient. Estimated blade temperature required is as low as 1200 F.

Many new and existing alloys, especially the cobalt and nickel-base superalloys, are being considered for cooled turbine blades. However, very limited data are available on these alloys at the lower temperatures. To fill in this gap, James H. Dance and Francis J. Clauss, Lewis Flight Propulsion Laboratory, studied the 100-hr rupture strength of several nickel-base sheet alloys at 1200 and 1350 F. The alloys evaluated were Inconel X, Inconel 700, Incoloy 901, R-235 and Refractaloy 26.

Originally presented in *Technical Note* 3976 of the National Advisory Committee for Aeronautics, the results of this study indicate that the best nickel-base alloys tested have greater 100-hr rupture strength at 1200 and 1350 F than other oxidation resistant sheet alloys for which data are available. Also:

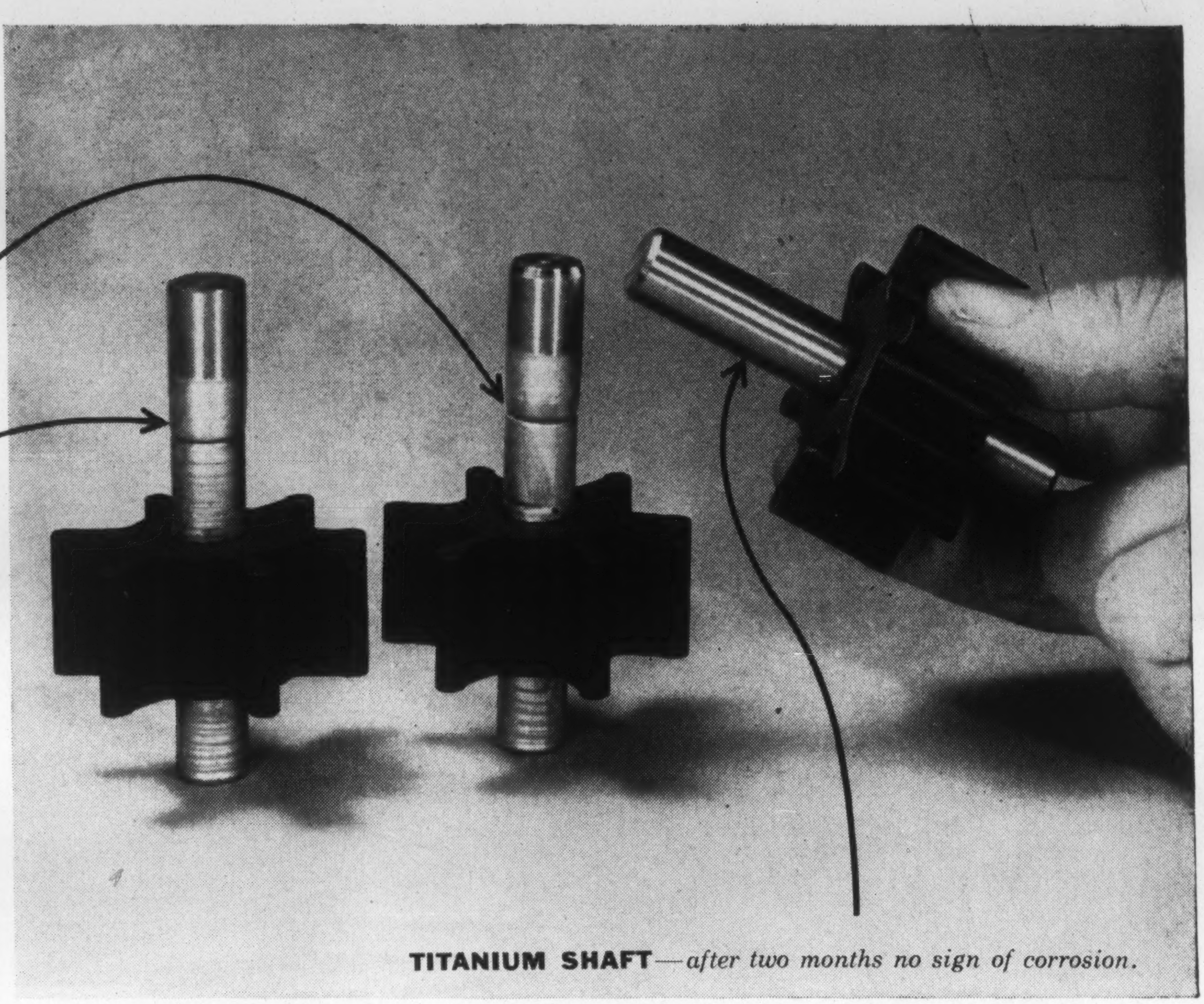
1. Of the nickel-base alloys studied, Inconel 700 and Incoloy 901 are strongest at 1200 F. The strongest alloys at 1350 F are Inconel 700 and R-235.

2. The precipitation hardening heat treatments used in the investigation strengthened all five alloys at 1200 F, but only Inconel X, Inconel 700 and R-235 were strengthened at 1350 F.

3. Nickel-base sheet alloys generally lack the ductility of cobalt and iron-base sheet alloys. Incoloy 901, which in the annealed condition stretched up to 20% in stress rupture tests, was the most ductile; the other nickel-base alloys elongated only about 1 to 5%.

4. Stress rupture fractures generally occur in the grain boundaries.

Progress with **TITANIUM**



SHAFTS WHICH FAILED AFTER 45 MINUTES. *Both are made of premium metals, one ferrous, one non-ferrous.*

TITANIUM SHAFT—*after two months no sign of corrosion.*

TITANIUM PUMP SHAFT LASTS

...where other metals corroded in 45 minutes

The problem was to pump ferric chloride, an acid used in etching printed circuits in electronics manufacturing. Jabsco Pump Company, of Burbank, California, sought to develop a pump to handle this highly corrosive acid, and replace batch handling.

Premium metals were tried for the pump shaft (the impeller is neoprene and the casing is plastic), but corrosion around the seal almost immediately led to leakage and failure. A glass shaft did not have sufficient strength. Then, using Mallory-Sharon commercially pure titanium for the shaft, the problem was solved—permanently. Titanium has outstanding resistance to chlorides.

The cost figures here are illuminating. The pump with the titanium shaft cost about double the pump with the ferrous metal shaft . . . and about the same as the pump with the other non-ferrous metal shaft (because of machining difficulty with the latter). So first cost of titanium is lower than you may think. And titanium paid for itself in *90 minutes*.

Let us help you apply titanium to your corrosion problems . . . our service engineering group will be glad to assist. For information, write Dept. G-6.

TYPICAL PRESENT APPLICATIONS OF TITANIUM

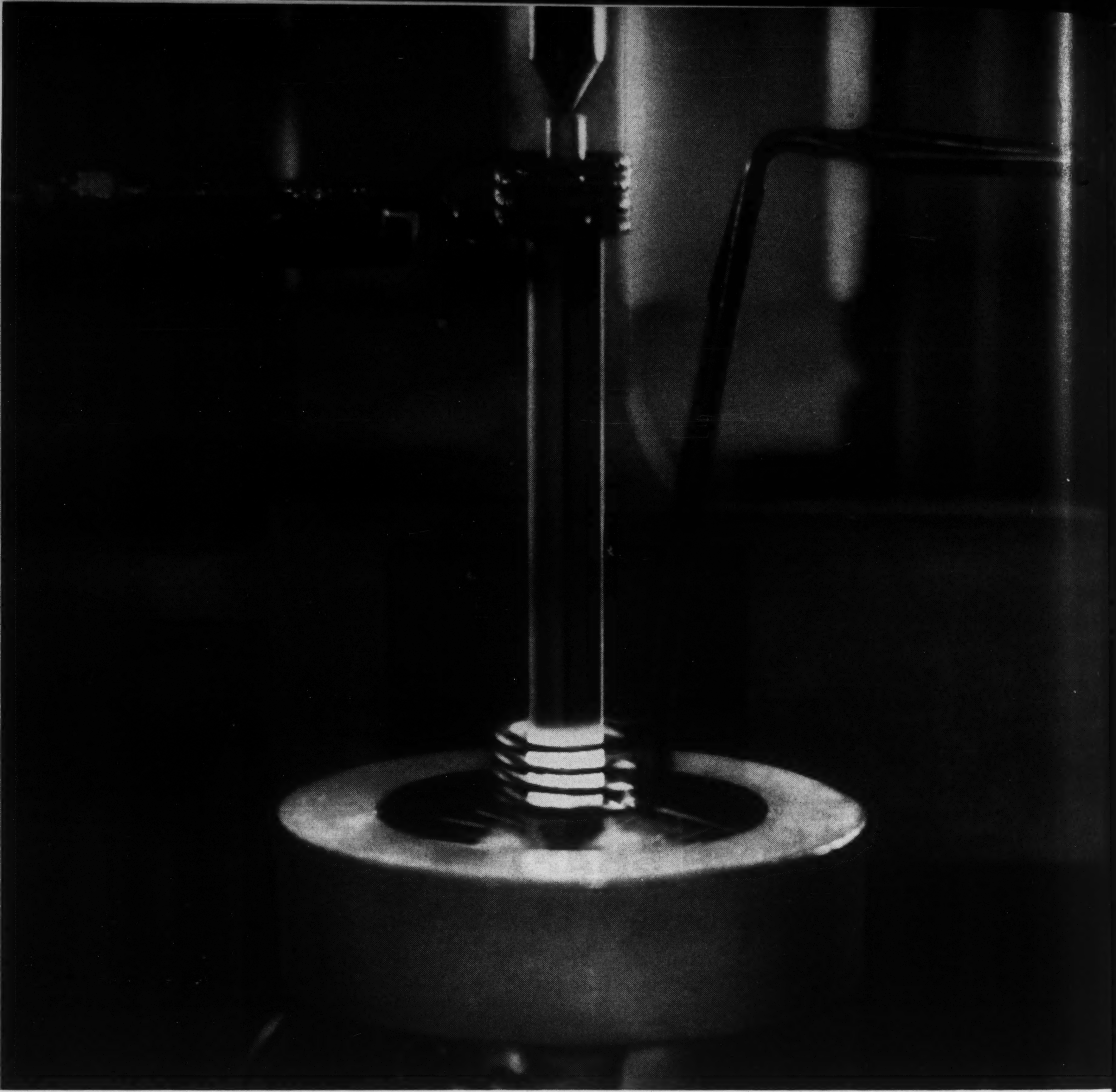
- Anodizing racks
- Condenser inserts
- Filters
- Heat exchangers
- Impellers
- Piping
- Process vessels
- Steam jet diffusers

MALLORY Ti SHARON

MALLORY-SHARON TITANIUM CORPORATION • NILES, OHIO

Producers of titanium and titanium alloy sheet, strip, plate, rod, bar, billets

For more information, turn to Reader Service Card, Circle No. 513



Ketos shaft being induction hardened to Rockwell 55-56, while ends remain soft for final machining. Photographed at Control Instrument Co., Inc., Brooklyn, N. Y.

KETOS has wide hardening range with minimum volume change . . .

Ketos is a low priced alloy tool steel that can be hardened from low temperatures with practically no volume change. It has deep hardening qualities, and a fine grained structure, that make it desirable for many production parts.

That's why nondeforming Ketos is well suited not only for most tool steel applications such as gauges, dies, and taps but also for close-tolerance, wear-resistant parts like the actuator bar shown in the induction heating unit above. The thin contact edges of this particular part withstood a "life test" of over 4-million high speed blows. No other steel tested lasted more than 1-million cycles before it chipped and failed.

If Ketos sounds like the steel you should be using, call your nearby Crucible warehouse. Stocks of Ketos and dozens of other special tool steels are large, delivery fast. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

Canadian Distributor — Railway & Power Engineering Corp., Ltd.

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PRICES AND SUPPLY

The Outlook by Herman B. Director, *Consultant, Washington, D. C.*

Demand for copper not predictable

For years the copper producing industry has based its predictions of copper consumption on the scale of 1.4 lb of copper used for each ton of steel produced. Although this may have been an accurate measure in the past, it has certainly failed to be reliable for 1957.

One reason for this is that any index based on measurements of widely divergent magnitudes—such as pounds and tons—is statistically unsound. For another, copper is related only to certain kinds of steel, namely that used in the automotive, electrical and home building fields. In heavy construction, e.g., freight cars, ships and industrial plants, the need for copper does not show as quickly as it does in the production of automobiles or appliances.

A more precise and up-to-date basis for forecasting short term (6 to 12 months) copper demand is necessary. Based upon the outlook for automotive appliances and home building, there is not going to be a great upsurge in demand for copper even though steel production continues at a high rate. In fact, the current 32¢ domestic price is under severe pressure and we feel that copper will not be consumed at the ratio of 1.4 lb to 1 ton.

1957 steel production to exceed 1956

Steel production in the first quarter of 1957 was maintained at the annual rate of 126 million tons. Second quarter prospects are for production at an annual rate of 120 million tons. Major mills (accounting for about 40% of the industry) predict near-capacity operations through the second quarter and even for the full year of 1957. Production is likely to decrease in the third quarter and then pick up again in the fourth.

As a result of very high first, second and fourth quarter rates, it seems almost a certainty that production in 1957 will exceed the 117 million tons produced in 1956. In fact, based on expected consumption in the construction, automotive, machinery, container, export, shipbuilding, railroad, appliance and other industries, production should approach 120 million tons.

Use of tungsten to increase?

According to U. S. Dept. of Interior spokesmen, consumption of tungsten will increase greatly as a result of atomic energy and other high temperature applications. We feel that this view represents a desire to continue Government subsidies rather than a promise of mass markets.

Standards to improve secondary materials

Consumers will probably receive better grade "certified" materials as a result of efforts on the part of the secondary materials industry to set standards. The latest step is creation of a committee of competent secondary dealers to set standards for preparing, marketing and utilizing nickel bearing scrap materials. Producers of materials such as lead, paper, steel and plastics rely heavily on scrap. Secondary materials of all kinds generally exert a healthy competitive "brake" on primary materials prices.

More nickel available now

There is now substantially more nickel available to industry than there was one year ago. In the second quarter of 1956 there were 64 million pounds of nickel available. The best estimate of second quarter 1957 availability is 72 million pounds, an increase of almost 20%. The many varieties of nickel, such as electrolytic, metallic pig, nickel powder, etc., are being offered at prices ranging from 70¢ to $1.60 per lb. Although total offerings are still short of demand, the long term outlook is for a surplus of nickel. The Government has announced that it is reviewing the nickel expansion goal with a view toward closing out Government support for further expansion. The odds favor such action.

Aluminum "puts"

There has been a great deal of discussion concerning the action of aluminum producers who have been exercising their right to "put" aluminum to the Government stockpile as provided under defense expansion contracts (written with the Government when the Government was urging the not-too-unwilling aluminum industry to expand). The total amount "put" to the Government for 1957 is 200,000 tons out of a possible 613,000 tons of new defense capacity. This appears as if the producers are giving up about one-third of their expanded production. The picture changes markedly, however, when we compare the "put" with total capacity as well as defense expansion for each producer:

	Tonnage "Put"	Defense Expansion	Total Capacity
Alcoa	125,000	205,000	792,500
Kaiser	43,500	228,000	434,500
Reynolds	32,500	180,000	488,500

Actually, the three producers are offering about 12% of their total production, as compared with about one-third of their expanded defense production. We hasten to add that 12% is still a sizable chunk of production, keeping in mind that aluminum capacity continues to expand vigorously.

Unless demand increases soon, and we don't think it will, next year's "put" will be much higher. The impact on consumers of the sale of aluminum to the Government under defense contract "put" rights is direct and twofold: 1) he pays via taxes for the aluminum that the Government buys and 2) the price stays "put."

Materials expansion goals closed

The Government has closed all but one of the expansion goals for materials. The latest victim is the mercury goal which was opened late in 1955. The only remaining open material goal is nickel.

An important lesson for the engineer is, therefore, that design engineering should be based on performance and economics and not supply. Supplies of all industrial materials, with only a very few minor exceptions, will be available in adequate quantities to meet production needs. There is no longer any shortage of once scarce "strategic" materials such as columbium, selenium, copper, lead, zinc, tungsten, cobalt, cadmium, vanadium, magnesium, aluminum or titanium. All of these materials were under tight Government allocation controls for reasons of "short supply" only a few years ago.

Zinc and lead prices may decrease

The price of zinc and lead may be reduced if Felix Wormser, Dept. of the Interior, is correct in predicting that the Government will stop buying lead and zinc for the already overloaded stockpile. The catch is, of course, that barter operations will continue. It is doubtful that barter alone will stabilize world production sufficiently to keep prices up, although it can go a long way in that direction. One U. S. producer, for example, has already announced that he is closing down major domestic production but continuing production at foreign-owned properties. Congressional budget cuts may well be the handwriting on the wall for minerals' subsidies, but it probably also means more intensive barter activities with fewer price reductions than would otherwise be the case.

Action by Congress in cutting out tungsten subsidies after a violent battle by minerals interests may not yet be final. For the moment, at least, it is fortunate that mineral subsidies did not survive as a rider on the "social security" appropriation bill. We doubt that consumers are prepared to accept minerals subsidies as a fixed charge along with old age pensions.

Titanium program curtailed

Industrial demand for titanium sponge for both defense and nondefense uses is far behind production capacity. As a result, the Government is currently curtailing its titanium sponge program in order to bring this program more in line with foreseeable demands.

A secondary effect could be a reduction in demand for magnesium since magnesium is an important ingredient in the manufacture of titanium by the Kroll process.

No industrial demand for titanium

About 99% of all titanium mill products produced in the U. S. goes into military applications. About half goes into aircraft compressor blades; the other half is divided among other aircraft applications such as combustion chamber linings and exhaust and jet pipe fittings. No major commercial markets have yet developed which require titanium mill products in quantity. The outlook is for a continued large surplus of titanium sponge. Difficulties remain in fabrication, especially shaping and welding. Lower prices would stimulate demand, but not before important applications data are collected and made available to consumers in a much more detailed and systematic form.

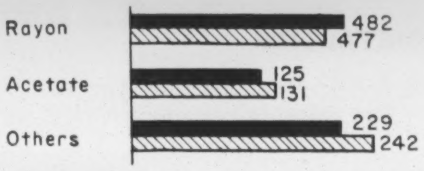
Survey Indicates Increased Production of . . .

■ Results of the recent survey conducted by the Chemical Marketing and Economics Div. of the American Chemical Society are now available. In the survey producers of certain materials were asked to predict what the production picture would be like for the period Jan to June, 1957. If the predictions shown here are correct, then production in four of the categories (synthetic fibers, plastics, synthetic rubber and surface coatings) has increased over production in the similar period last year.

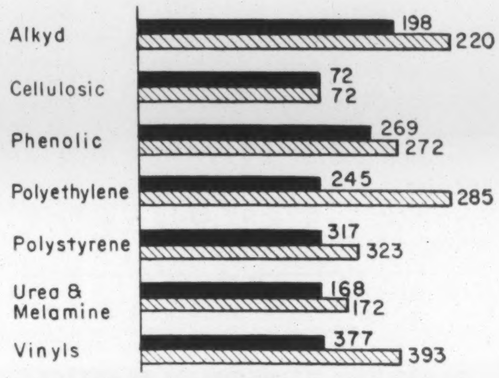
The purpose of the survey (which will be repeated for the period July to Dec) is to provide industry with a general idea of what to expect long in advance of official Government statistics, which appear once a month for some of the materials, semi-annually for others, and only annually for still others. As a result of the sporadic publication of these data, verification of prognostications cannot, in most cases, be made until the end of the year.

The charts shown here are not scaled. Light areas indicate producers' estimates; shaded portions represent actual figures for the same period last year.

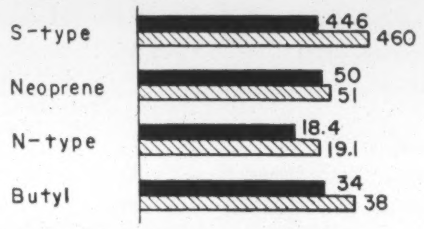
Synthetic fibers
(millions of pounds)



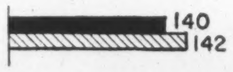
Plastics
(millions of pounds)



Synthetic rubber
(thousands of long tons)



Industrial finishes
(millions of gallons)



Tin: Latest Figures Show a Drop in U. S. Use, World Production

■ Total U. S. consumption of tin in 1956 was 300 long tons less than consumption in 1955, according to the Bureau of Mines. If not for the fact that the tinplate industry consumed 4% more primary tin in 1956 than in 1955, the decline in tin use would have been even more pronounced. Total tin consumed in 1956 was 90,200 long tons (60,700 tons of primary and 29,500 tons of secondary) compared to 90,500 tons in 1955 (59,800 tons of primary and 30,700 tons of secondary). The use of tin in all industries except tin plate decreased by 3%—1200 tons less for solder, 500 tons less for bronze and 115 tons less for tinning.

The largest single use of tin in the U. S. is tinplating. In 1956 it accounted for 34,900 long tons —about 55% of world consumption. Of that amount 62% was used for electrolytic plating and 38% for hot dip coating. Use of the electrolytic process has been growing steadily for the past few years and indications are that the future will see an even larger percentage of tin going into electrolytic tinplating. Price of tinplate was recently increased by 4½%.

World mine production of tin in 1956 decreased by 1%. Total world production was 177,600 long tons, compared to 180,243 tons produced in 1955. The tin fields of Malaya accounted for 35% of the total, Indonesia 17%, Bolivia 15%, Belgian Congo 8%, Thailand 7%, Nigeria 5%, and all remaining sources 13%. Production in Malaya and Thailand was the highest for these countries since 1941, but Bolivian production decreased for the third successive time to the lowest level since 1939. As far as the supply-demand picture is concerned, excluding strategic stockpiling, world production was 15,000-20,000 tons in excess of world consumption.

U. S. imports of metallic tin in 1956 were 3% below imports in 1955. This was the fourth succeeding yearly decrease and the longest period of continuous curtailment ever recorded in tin imports. Of the total, Malaya furnished 68%—10% below that supplied in 1955 and the lowest since 1951.

Average 1956 price of Straits tin for prompt delivery in New York was \$1.01 per lb—7% above the average for 1955. The price decreased during the first half of the year, increased sharply in May and then dropped to a low of 92¢ per lb in July. The Suez situation brought the price up sharply to \$1.14. At the end of the year, however, the price settled down to about \$1.00. Present price is 99¢ per lb.

(Prices on p 232; more News on p 236)

Prices of Materials

Changes since last month are bold faced

NONMETALLICS

Prices for large quantities for range of grades, color, sizes; given in $/lb

RUBBER

Material	Dry	Latex
Butadiene-Acrylonitrile	.49-.65	.44-.54
Butadiene-Styrene	.17-.30	.26-.32
Butyl	.23-.28	—
Neoprene[a]	.39-.75	.37-.47
Silicone[a]	1.90-4	—
Polysulfide[a]	.47-1	.70-.92
Natural	.33[b]	—

[a] Less than carload quantities.
[b] Average spot price for month of Apr.

GLASS FOR REINFORCED PLASTICS

Fabric ($/yd, 38 in. wide)[a]	
112 Woven	.48
181 Long-shaft satin weave	.03
143 Unidirectional	1.00
Roving[a]	
Continuous	.40
Continuous spun strand	.36
Continuous chopped spun	.38
Milled fibers (1/32-¼ in.)[a]	.45
Mat	
Chopped strand (2 in.)[a,b]	.52-.72
Surfacing ($/1000 sq ft)[c]	10-19
Continuous chopped strand (¼-2 in.)	.40

[a] Price includes binder or finish.
[b] Price varies with binder.
[c] 0.010-0.020 in. thick.

THERMOSETTING PLASTICS

Material	Molding Compounds	Laminating, Casting Resins
Alkyd	.34-.53	—
Epoxy	—	.45-.80
Melamine	.42-.45	.40-.41
Phenolic	.20-.40	.17-.34
Polyester	.42	.32-.50
Silicone	2.75-5.40	1.55-1.74[a]
Urea	.19-.33	—

[a] 60% solids content.

All prices are approximate and given solely for general guidance of those responsible for materials selection.

THERMOPLASTICS

Material	Molding Compounds	Sheet (.030-.250 in.)	Rod		Tube	
			⅛-¼ in.	⅜-1¼ in.	⅛-¼ in.	⅜-1¼ in.
Acrylic	.51-.59	.49-2.15	.90-1.15	.80-.90	1-1.15	.90-1
Cellulosic						
Acetate	.36-.65	.92-1.16	.75-1	.65-.75	.85-1	.75-.85
Butyrate	.50-.72	1-1.28	.95-1.20	.85-.95	1.05-1.20	.85-1.05
Nitrate	—	1.60-2.73	1.45-1.75		2.25-5.00	
Propionate	.51-.63	—	—		—	
Fluorocarbon						
PTFCE	7-8	15-23	18-22	14-20	20-22.50	16-20
PTFE	4.50-7.45	14.30-11	13		13	
Nylon	1.35-2.30	—	3		3	
Polyethylene	.37-.56	.85-1	.75-1	.65-.75	.85-1	.75-.85
Polystyrene	.27-.44	.57-.61	.65-.90	.55-.65	.75-.90	.65-.75
Vinyl	.27-.43	.62-.92	.75-1	.65-.75	.85-1	.75-.85

NONFERROUS METALS

Mill base prices for large quantities; given in $/lb except where indicated

ALUMINUM

Pig (99-99.9%)	.25-.27
Ingot (99-99.9%)	.27-.29
Foil (5-0.5 mil)	.55-.77
Alloy Ingot (13, 43, A132, 214)	.29-.32
Sheet (1100, 3003; 3-.03 in.)[a]	.40-.45
Plate (1100, 3003, 5050, 3004, 5052)[a]	.40-.43

[a] Mill finish.

BRASS

Form	Cart., 70%	Low, 80%	Red, 85%
Sheet, Strip	.48	.50	.51
Seamless Tubing	.50	.53	.54
Rod (not f.c.)	.47	.50	.51
Wire	.48	.51	.52

COPPER

Ingot (elec)	.32
Sheet, Strip (hot rolled)	.54
Seamless Tubing	.54
Rod, Drawn	.51
Rod, Free Cutting	.60
Wire	
Round	.37
Square, Rectangular	.41
Magnet	.45

LEAD

Common Grade	.16

MAGNESIUM

Pig (98.8%)	.36
Ingot (98.8%)	.37
AZ91B Ingot (die casting)	.37
AZ91C Ingot (sand casting)	.41[a]

[a] Delivered price.

NICKEL

Form	"F"	"A"	Monel
Ingot	.75[a]	—	—
Rod	—	1.07	.89
Sheet, C.R.	—	1.26	1.06
Strip, C.R.	—	1.24	1.08
Seamless Tube	—	1.57	1.29

[a] Delivered price.

TIN

Primary[a]	.99-1

[a] Delivered price.

(continued on adjacent page)

NONFERROUS METALS

(continued)

TITANIUM

Sponge (99.3+%)	2.50-2.75
Bars, Rod	7.10-7.35
Plate	9.25-11.25
Sheet, Strip	11.40-12.10
Wire	8.50-9.00

ZINC

Primary[a]	.13-.14[c]
Die Casting Alloys[b]	.18-.19[c]
Sheet	.24
Ribbon	.22

[a]Prime Western—Special High Grade.
[b]Alloys 2, 3, 5. [c]Delivered price.

METAL POWDERS

Aluminum [a,b]	.36
Brass[a]	.37-.47
Copper (elec or red.)[a]	.46
Columbium	120
Molybdenum (98%)	3.80-4.10
Tantalum	49
Tungsten (C-red. 98.8%; H_2-red. 99+%)	4-5[c]
Zirconium	
Flash Grade	11.50
Electronics Grade	15

[a]Price for —100 mesh. [c]Delivered price.
[b]Freight allowed.

OTHER NONFERROUS METALS

Cadmium (bars)	1.70
Gold	$35/troy oz
Indium (99.97+%)	$2.25/troy oz
Manganese (99.9%)	.34[a]
Palladium	$23-24/troy oz
Platinum	$92-95/troy oz
Silver	91¢/troy oz
Tantalum (sheet, rod)	55-60
Vanadium	3.45
Zirconium (sheet, strip, bar)	27-35

[a]Delivered price.

IRONS AND STEELS

Mill base prices for large quantities

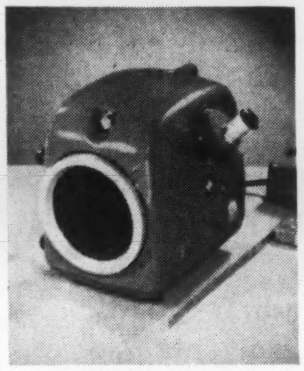
SEMIFINISHED STEEL ($/net ton)

Ingots, Alloy	74
Billets, Blooms, Slabs	
Carbon, Re-rolling	74
Carbon, Forging	92
Alloy, Forging	107
Seamless Tube Rounds	112
Wire Rods	$5.85/cwt

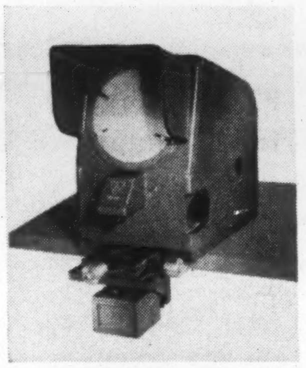
(continued on p 234)

PRECISION PRODUCTION PROBLEMS?

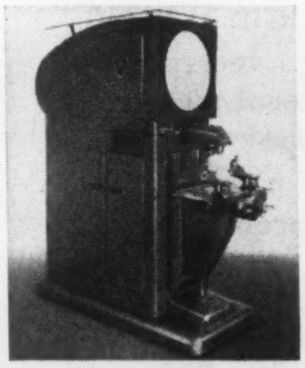
Here's help from Bausch & Lomb in TOOL DESIGN INSPECTION FABRICATION MEASURING TESTING



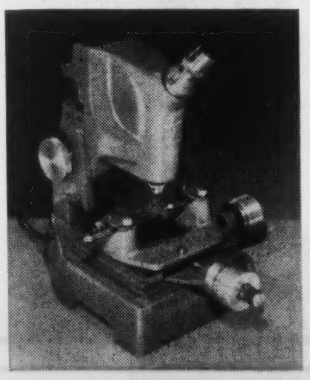
NEW! ALIGNMENT INTERFEROMETER
Accurately measures small changes in angle over a range of 30 seconds of arc (±15 seconds). Easy direct scale readings to 0.2 seconds (0.000006″).



BENCH COMPARATOR
Exclusive under-stage illumination—no complex set-ups, no holding fixtures for most work. Magnified silhouettes show errors instantly. Reads to 0.0001″ with optional micrometer stage.

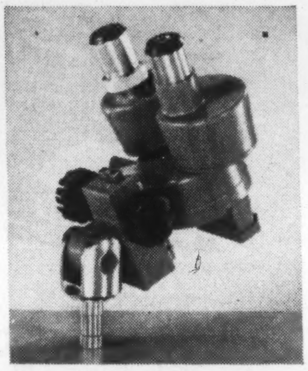


CONTOUR MEASURING PROJECTOR
Shows magnified silhouettes or surface views. Simple operation, highest precision measurements: to 0.0001″, linear; to 1 minute of arc, angular.

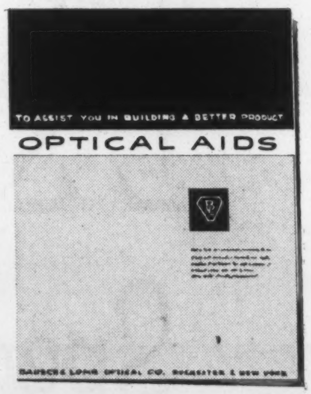


NEW TOOLMAKER'S MEASURING MICROSCOPE
Quickly measures opaque or transparent objects of any contour. Linear, accurate to 0.0001″; angular, to 1 minute of arc.

STEREO-MICROSCOPES
Magnified 3-D views of tiny parts. Dust-proof, shockproof, can be mounted right in machine or fixture. Speeds assembly, inspection. Most complete line, widest field of view.



OPTICAL AIDS CATALOG
Time-and-money-saving data on Surface Comparators, Industrial Magnifiers, Macroscopes, Microscope Bodies, Micrometer Discs, Wide Field Tubes, Brinell Microscopes, Shop Microscopes.



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For more information, turn to Reader Service Card, Circle No. 496

PRICES AND SUPPLY

FINISHED STEEL ($/cwt)

Form	Carbon	High Str Low Alloy	Alloy
Plate	4.85	7.25	6.85
Sheet, H.R.	4.67	6.90	—
Sheet, C.R.	5.75	8.52	—
Strip, H.R.	4.67	6.95	7.75
Strip, C.R.	6.85	10	14.55
Bar, H.R.	5.07	7.42	6.12
Bar, C.F.	6.85	—	8.32

STAINLESS STEELS ($/lb)

Material	Forging Billets	H. R. Bars	Plate[b]	Sheet, Strip
Austenitic				
301, 302, 302B, 303, 304, 305	.36-.40	.41-.46	.45-.49	.50-.56
321[a]	.45	.53	.58	.63
347[a]	.54	.62	.67	.76
Martensitic				
410[a]	.27	.33	.34	.39
416	.28	.33	.35	.47
403	.31	.36	.39	.47
420, 440	.33	.40	.44	.60
Ferritic				
405, 430, 430F[a]	.28-.29	.33-.34	.35-.36	.39-.50
442	.32	.38	.40	.54
431	.36	.43	.44	.54
446	.38	.45	.46	.67
High Mn				
202[a]	.35	.41	.43	.47
Extra-Low C				
304L	.47	.54	.56	.61
316L	.64	.74	.78	.82
Precip Hard.				
17-7PH	.55	.65	.72	.77-.82

[a] **Ingot prices approx 60% of forging billet price.**

METAL POWDERS ($/lb)[a]

Sponge Iron	.09-.10
Electrolytic Iron	
Annealed (99.5%)	.37
Unannealed (99+%)	.34
Stainless Steel	
304	1.05
316	1.44

[a] **Price for —100 mesh.**

IRON ($/gross ton)

Pig	64.50-65.50

(continued on p 236)

Special Reports On Finishing Non-Ferrous Metals

NUMBER II—Paint Base, Corrosion-Resistant Finishing with Iridite

WHAT IS IRIDITE®?

Briefly, Iridite is the tradename for a specialized line of chromate conversion finishes. They are generally applied by dip, some by brush or spray, at or near room temperature, with automatic equipment or manual finishing facilities. During application, a chemical reaction occurs that produces a thin (.00002" max.) gel-like, complex chromate film of a non-porous nature on the surface of the metal. This film is an integral part of the metal itself, thus cannot flake, chip or peel. No special equipment, exhaust systems or specially trained personnel are required.

Chromate conversion coatings are well known and accepted throughout industry as an economical means of providing corrosion protection, a good paint base and decorative finishes for non-ferrous metals. However, continued developments have been so rapid and widespread that many manufacturers may not be completely aware of the breadth of application of this type of finish. Hence, this digest of current information, to bring you up to date on the many ways in which you can obtain proper surface preparation for painting and increase product durability with a single multi-purpose chemical pretreatment. Report I on decorative, corrosion-resistant finishes and Report III on chemically polished, corrosion-resistant finishes are available on request.

First, it is an accepted fact that metal surfaces should be prepared before painting to make possible an efficient paint system. Naturally, this preparation should provide for good initial paint adhesion. Chemical treatments have proved extremely effective in this respect, particularly those of a neutral or preferably acid nature. Further, to be most efficient, chemical treatments should provide a non-porous barrier to maintain adhesion by sealing the metal from the paint and moisture. They should also provide a self-healing film which prevents lateral corrosion in the event that bare metal is exposed through scratching.

The Iridite chromate conversion coatings meet all these requirements. Iridite is a chemical conversion treatment for surface preparation. It provides initial paint bonding by molecular adhesion. It is acid in nature and produces a film that is gel-like and non-porous in structure. Thus, the Iridite film effectively seals the metal from the paint and from moisture penetration. Because the film contains certain relatively soluble constituents, it will protect areas scratched through to bare metal and prevent lateral corrosion. This is accomplished by a gradual leaching of these constituents into the damaged area.

Further, because of its gel-like, non-crystalline nature, the Iridite film will not affect the appearance or texture of the paint film, nor will it dust or powder to mar the painted surface. Because the film is non-porous, paint coverage is increased, thus substantial savings in paint costs will be realized. In addition, treated parts may be stored for long periods of time prior to painting without the risk of entrapped moisture causing blistering when painting.

Iridite chromate conversion coatings are widely used with equal ease and success under both baked and air-dried paint systems. While the actual adherence properties of the Iridite film do not increase appreciably with its thickness, corrosion protection does. The protection of the Iridite film is proportionate to its thickness and should be taken into consideration when selecting the Iridite to meet your needs. However, it is sometimes necessary to sacrifice maximum corrosion protection for appearance when a finished part is to be only partially painted. For example, it may be desirable to use a thin, clear, bright Iridite film if the unpainted areas must present a chrome-like appearance. A typical case is that of instrument housings on which the exterior is painted and the inside left unpainted.

On the other hand, if all surfaces of the product are to be painted and maximum corrosion protection is required, the heavier and most protective Iridite films should be used. For example, all surfaces of zinc die cast fruit juicers are finished with a highly protective Iridite film prior to painting to provide maximum resistance to the corrosive action of fruit juices.

Iridite finishes are now available for all commercial forms of the more commonly used non-ferrous metals, including zinc, cadmium, aluminum, magnesium, silver, copper, brass and bronze. In addition to providing an excellent base for paint, the Iridite films also have high decorative value when used as final finishes in themselves.

These films can produce a wide variety of pleasing appearances including clear bright, iridescent yellow, bronze, olive drab and brown. In addition, many films can be modified by bleaching or by dyeing. Among the dye colors available are various shades of red, yellow, green, blue or black.

In planning or designing, you should consider the many other characteristics of Iridite finishes which may enter into the specific problem. In addition to their functions as protective and decorative finishes, and as bases for organic finishes and bonding compounds, Iridites have low electrical resistance. Some can be soldered and welded. The film does not affect the dimensional stability of close tolerance parts.

Iridites are widely approved under both Armed Services and industrial specifications because of performance, low cost and savings of materials and equipment.

You can see then, that with the many factors to be considered, selection of the Iridite best suited to your product requires the services of a specialist. That's why Allied maintains a staff of competent Field Engineers—to help you select the Iridite to make your installation most efficient in improving the quality of your product. You'll find your Allied Field Engineer listed under "Plating Supplies" in your classified telephone book. Or, write direct and tell us your problem. Complete literature and data, as well as sample parts processing, is available. Allied Research Products, Inc., 4004-06 East Monument Street, Baltimore 5, Maryland.

(Adv.)

For more information, turn to Reader Service Card, Circle No. 376

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. . . a fast, economical method for producing a specified case depth

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Equipment costs are materially lower than those of any other production carburizing system. Exceptionally long pot life minimizes maintenance. Most important, you get fast heating, close control of case depths, and a minimum of distortion. There is no spalling or pitting. Work is quenched directly from the carburizing bath . . . no reheating is necessary. Selective hardening is easy. Where needed, carburizing and brazing may be done at the same time . . . carburizing can be combined with martempering in one heating . . . or several batches may be hardened to different case depths simultaneously.

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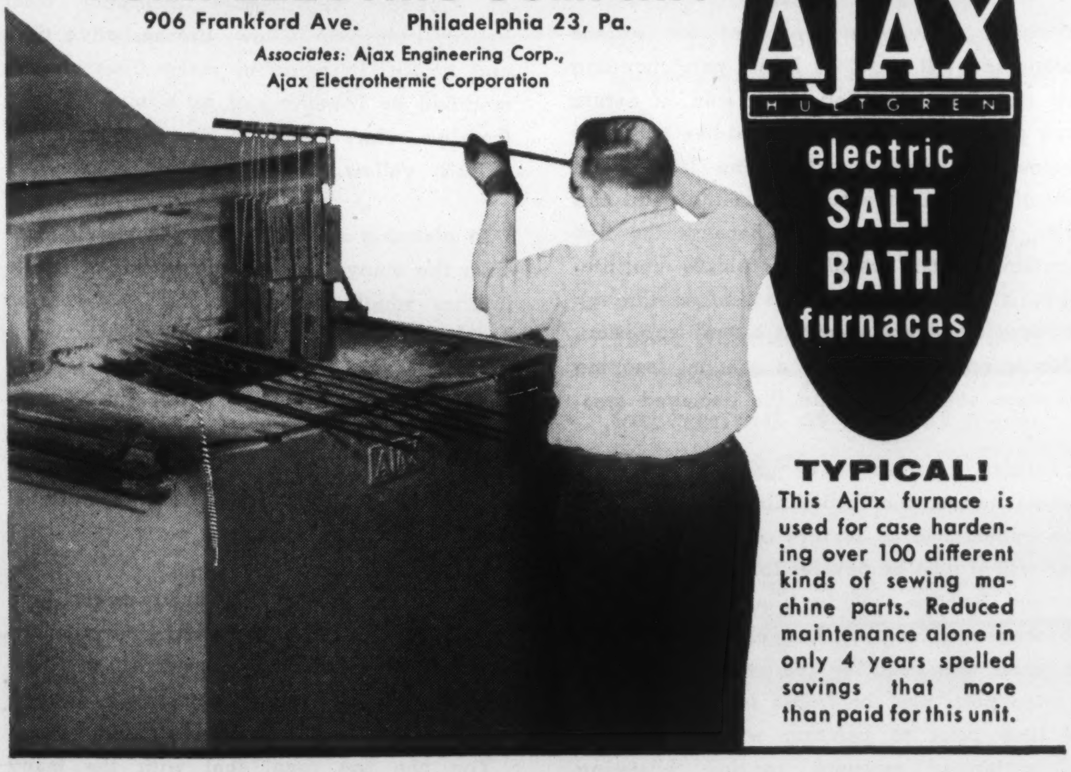

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CLEVELAND 13, OHIO: Anderson-Bolds, Inc., 2012 W. 25th St.—Prospect 1-7112
DENVER 2, COLORADO: E & M Equipment Co., 2415—15th St.—Glendale 5-3651
DETROIT 35, MICH.: J. E. Bullock, 19449 James Couzens Hwy.—Broadway 3-1211
ELMHURST, ILL.: O. M. Haseltine, 129 N. York St.—Terrace 2-7107
GLENSIDE, PA.: John P. Clark, Jr., 124 S. Easton Rd.—Turner 7-1776 or 1777
GOSHEN, OHIO: Ralph D. Hawkins, Box 196—Parkway 1-6444
HAMDEN 18, CONN.: Joseph M. Halloran, 63 Mowry St.—Chestnut 8-3069
LOS ANGELES 22, CALIF.: A. W. Nash, 2112 S. Atlantic Blvd.—Angelus 9-7304
MOUNTAIN LAKES, N. J.: Roger Stuart Brown, 7 Point View Place—Deerfield 4-0578
NASHVILLE 4, TENN.: H. R. Miles & Assoc., 2508 Franklin Rd.—Cypress 2-7016
NEW YORK 6, N. Y.: Roger Stuart Brown, 136 Liberty St.—Rector 2-9638
ORINDA, CALIF.: George H. Thurston, 1 Estates Court—Clifford 4-5411
PITTSBURGH 22, PA.: McQuiston & Gibson, 310 Renshaw Bldg.—Atlantic 1-3721
SEATTLE 4, WASH.: H. E. HARTLEY, 230 Hudson St.—Mohawk 7120
TONAWANDA, N. Y.: A. C. Towne, Jr., Charles Percival, Jr., 1456 Niagara Falls Blvd.—Amherst 1468

For more information, turn to Reader Service Card, Circle No. 419

PRICES AND SUPPLY

TIN PLATE ($/base box)

Hot Dip (1.25-1.50 lb)	10.05-10.30
Electrolytic (0.25-0.75 lb)	8.75-9.40
Black Plate	7.85-7.95

FINISHES AND COATINGS

ORGANIC COATINGS

Material	Avg Thk per Coat, mil	Mils Required[a]	Cost, ¢/sq ft/dry mil[b]
VARNISHES, ENAMELS			
Short Oil Phenolic			
Varnish	1.0	1.0	1.50
Enamel	1.2	1.0	1.75
100% Phenolic	1.0	1.5	1.75
Straight Oil-Modified Alkyd	1.5	1.5	1.50
Alkyd-Amine (90-10)	1.5	1.5	1.75
Alkyd-Phenolic (50-50)	1.5	1.5	1.75
Alkyd-Vinyl (50-50)	1.0	2.0	2.0
Alkyd-Styrene (70-30)	1.2	1.5	1.75
Epoxy	1.8	1.8	2.00
Silicone	.5-1.0	.5-1.0	6.0
Furane	2.0	2.0	1.0
Neoprene	5.0	5.0	1.50
DISPERSION COATINGS			
Phenolic	1.0	1.5	1.75
Vinyl	1.0	2.0	2.50
Fluorocarbon	1.0	1.0	15.0
LACQUERS			
Nitrocellulose	1.0	2.0	2.50
Vinyl	1.0	2.0	2.50
Acrylic	1.0	2.0	2.75

[a] Thickness over phosphate coating required for exterior durability on steel. For purely decorative coating, 1 mil will usually suffice.
[b] Materials cost only. Realistic price comparison can be made only on basis of dry applied coating, not on basis of cost per gallon.

What's Happening in Prices and Supply

Copper — Chicago Extruded Metals Co. reduced its price of free cutting brass rod by 2¢ per lb, making the price 35.69¢ per lb. Scovill Mfg. Co. immediately followed suit and indications are that other major producers will do the same.

Silicon—Within the next five

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for more than 15,000 customers in
50 varied industries throughout the world!
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- Electrical Manufacturing
- Electroplating
- Enamel
- Engraving and Electrotyping
- Feed Stuff, Mineral Feed
- Fertilizer
- Food
- Glass
- Insecticide and Fungicide
- Laundry
- Leather
- Lithographing
- Linoleum and Floor Covering
- Lubricant
- Match
- Metallurgical
- Metal Working
- Oil Cloth
- Optical
- Paint, Varnish and Lacquer
- Paper
- Petroleum
- Pharmaceutical
- Photographic
- Porcelain Enamel
- Plastics
- Pottery
- Printing Ink
- Pyrotechnic
- Refractories
- Rubber
- Shade Cloth
- Soaps
- Textile
- Veterinary Remedies
- Welding Electrodes
- Wall Paper

Here are typical Harshaw chemical products

- Electroplating Salts, Anodes and Processes
- Organic and Inorganic Dry Colors and Dispersions
- Driers and Metal Soaps
- Vinyl Stabilizers
- Ceramic Opacifiers and Colors
- Fluorides
- Glycerine
- Preformed Catalysts, Catalytic Chemicals
- Synthetic Optical Crystals
- Agricultural Chemicals
- Fungicides
- Chemical Commodities

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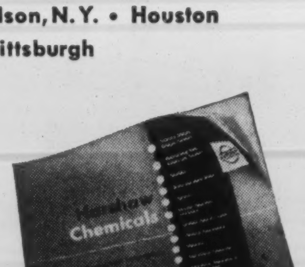

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NICKELOID METALS OFFER NEW DESIGN FREEDOM FOR LIGHTOLIER

Here's what Lightolier, 346 Claremont Ave., Jersey City, N.J. says: "Your Bakekote-coated polished brass gave us the freedom to design units which would otherwise have been prohibitive in price."

More Than a Metal—It's a Method

Whether *your* product is lighting, housewares, appliances, hardware specialties or stoves . . . in the 14 finish-to-base metal combinations of Nickeloid Pre-Finished Metals you will find the *right* design material to fit the scheme of your design theme. Nickeloid Metals offer new freedom in design, save production time, lower costs, reduce rejects.

Plan your design around these versatile metals — available in chrome, nickel, copper or brass finishes on base metals of steel, zinc, copper, brass or aluminum. Specify Nickeloid, the *modern* metal.

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Send for free Sampler-Selector, containing 8 actual metal samples and specifications.

NICKELOID METALS
SINCE 1898

American Nickeloid Co.
PERU ILLINOIS

For more information, turn to Reader Service Card, Circle No. 403

years the use of silicon should increase to 100,000 lb per year, according to Dr Donald R. Mason, consultant, Aries Laboratories. Consumption in 1956 was 10,000 lb. Dr. Mason predicts that the material will be used in a "myriad of applications" from light meters to automobiles. He estimates that by 1960 six silicon rectifiers will be used in each car.

Aluminum — Reynolds Metals Co. will expand its manufacturing facilities to increase its output of sheet and plate by 150,000 tons annually.

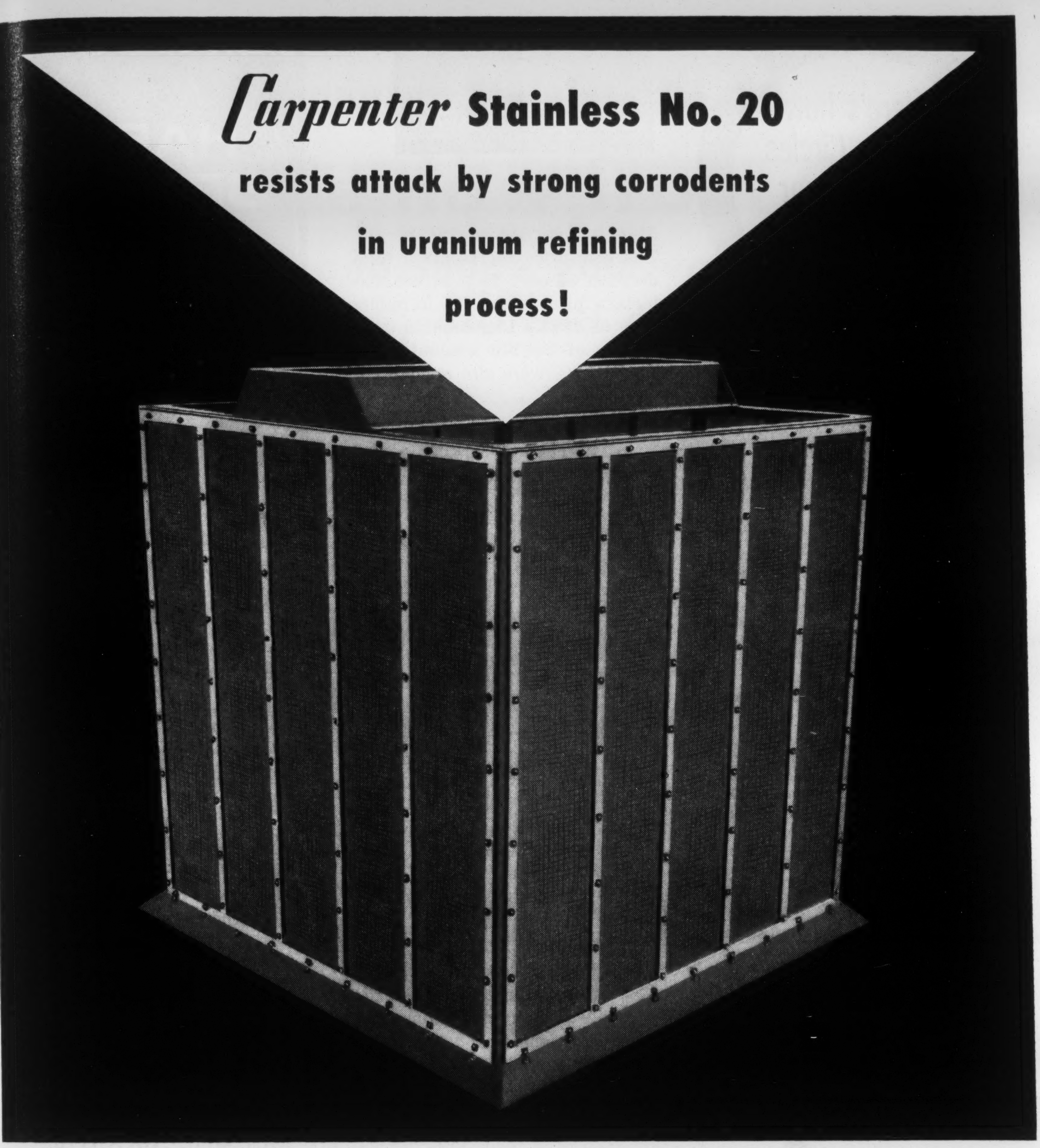
Steel—In an effort to double its steel capacity, Kaiser Steel Corp. has completed arrangements for an $81 million expansion program. Present steel capacity of 1,536,000 tons a year will be increased to approximately 3 million tons. Principal increases will be in plate, sheet, tinplate and pipe products.

Jones and Laughlin, the nation's fourth largest steel producer, will operate at 95% of capacity for the full year 1957, according to Avery C. Adams, president. The company operated at 102% during the first quarter and is now operating at 100.1% of capacity.

Polyethylene — Phillips Petroleum Co. is now producing on a commercial scale its new high density (low pressure) polyethylene. The company expects to produce 75 million pounds per year. Price of the material is 47¢ per lb delivered for natural uncolored in shipments of 20,000 lb or more.

Investment castings — Production of polymerized ethyl silicate has recently been started by Monsanto Chemical Co. in this country. The material, used as the mold material in investment casting, had previously been produced in England.

Vinyl film—Goodyear Tire and Rubber Co. cut the price of its Vitafilm packaging material by



Carpenter Stainless No. 20 resists attack by strong corrodents in uranium refining process!

Here's how one company solved a tough corrosion problem in setting up a new method of extracting uranium from ores.

Frame members and the 35 mesh screen which covers five sides of these 48″ cubical shaped dipping baskets are made of Carpenter Stainless No. 20 for super corrosion resistance.

The baskets are loaded with ion-exchange resin and agitated in a tank through which flows slime bearing sulphuric acid pulps containing uranium in solution. In this process, the uranium values are removed from the solution and retained in the resin. Later these uranium values are removed with a nitrate solution, then precipitated as a refined, high-grade salt.

Carpenter Stainless No. 20, available in 8 forms, is a proven material for super corrosion resistance in the nuclear energy field. Call your nearest Carpenter Distributor or talk to our mill specialists now.

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Alloy Tube Division, Union, N. J.

Export Dept.: The Carpenter Steel Co., Port Washington, N Y.—"CARSTEELCO"

Carpenter

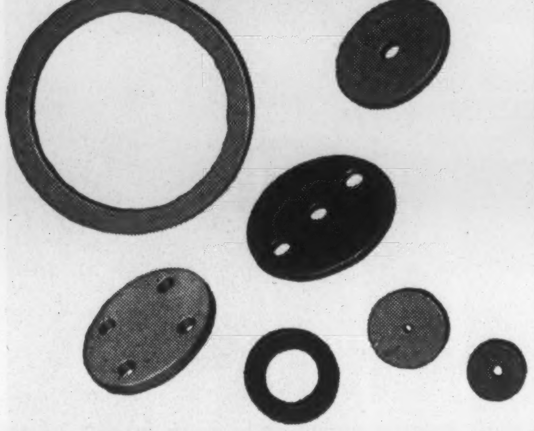
more than corrosion resistance

Stainless No. 20 and No. 20Cb

Carpenter No. 20 bars, strip, wire and billets are available also from The Carpenter Steel Company, Reading, Pa.

For more information, turn to Reader Service Card, Circle No. 537

Here's how to Run Circles around your Blanking Costs

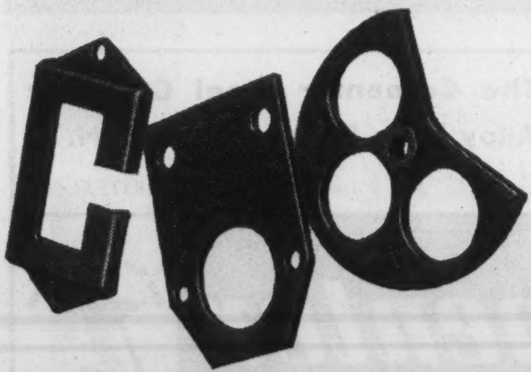


From washers to sprockets; from cams to gears—*steel plate blanks* supply the ideal base for a host of circular parts . . . And for special shapes, too.

Speaking of circles (discs, rings, bosses, sprocket blanks, plates) you can figure we save you time, and die and machinery costs, with our stock dies—*almost every fractional diameter up to 26½ inches!*

And for parts that must be "out of round"—special shapes to your design—you can bank on faithfulness to drawings, close tolerances and absolute flatness.

Press capacity for steel plate 3/16" to 1¼" thick. Machining and heat treating operations available. Large inventory in mild and high carbon steel. Custom service at prices you'll applaud. Let's get together. Write, phone or wire!



Cleveland Pressed Products Corporation
6714 Union Ave., Cleveland 5, Ohio
VUlcan 3-7900

For more information, Circle No. 425

5½%—from 84¢ to 79¢ per lb. The new price represents a total decrease of over 25% in the material's price since its introduction in 1953. Increases in production of the film amounting to about 150% were also announced.

Cellophane—Use of cellophane for packaging is expected to increase sharply, according to Mr. George R. Johnson, sales manager of the Film Div., Olin Mathieson Chemical Corp. Olin Mathieson is building a new cellophane plant, to be ready this summer, which will approximately double its output. By 1960, production of cellophane will reach 600 million pounds per year, compared to the 400 million pounds produced in 1956, according to Johnson.

Urethane foam—Leading producers are said to be planning huge increases in urethane foam production. Mobay Chemical Co. predicts a possible output in 1960 of more than 100 million pounds per year. Urethane foam production in 1956 was 10 million pounds.

Tetrafluoroethylene — Du Pont has lowered its Teflon resin price by 40¢ per lb on full truckload shipments of any one composition. Reductions of 15¢ per lb on 2000-lb loads and 30¢ per lb on 10,000-lb loads have also been effected. Prices on shipments of less than 2000 lb have not been changed except for certain container sizes of Teflon 6 and Teflon 30. Prices for Teflon 6 in 50-lb containers are 15¢ per lb lower; prices of Teflon 30 in 30-gal containers are 10¢ per gal lower.

More Stainless Steel Produced in 1956

According to figures recently released by the American Iron and Steel Institute, shipments of stainless steel to major industries

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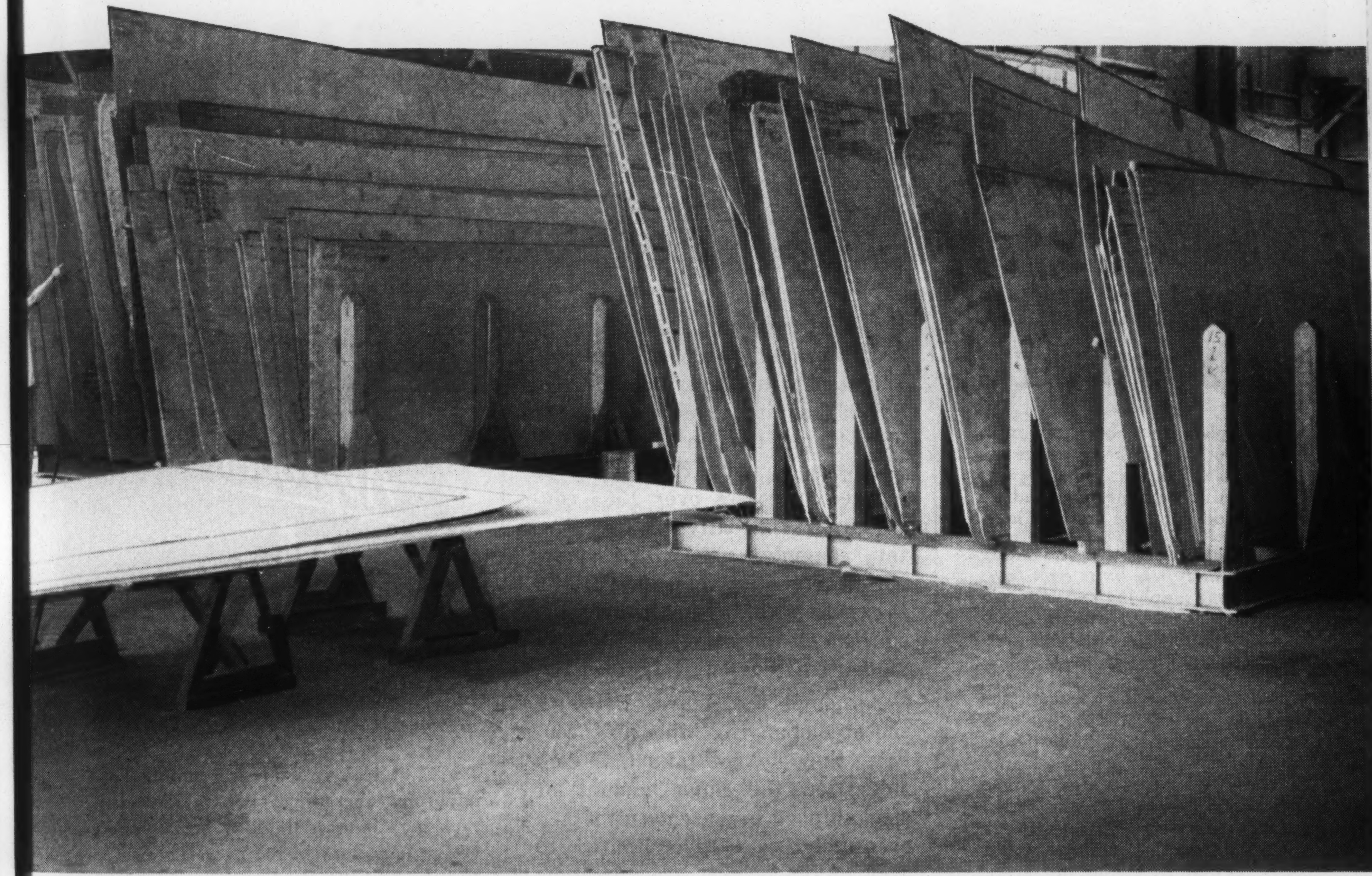
Available now from Carlson

. . . any size and shape you want in Types 405, 410 and 430 stainless plate



Carlson's stock of Types 405, 410 and 430 chromium stainless plate is the largest ever. You can order plates, large or small, and get delivery in a few days. Types 405 and 410 find wide application in petroleum processing. Type 430 is generally used for furnace parts, annealing boxes and nitric acid storage tanks. Consider the 400 series if you need stainless plates right now.

Prompt delivery isn't your only advantage. These grades cost less than chromium-nickel stainless steels and if you need irregular shapes and sizes, experienced men with specially designed equipment can cut your plates and get them out in a hurry. Carlson provides a complete service with a flexible operation to take care of your specific requirements. This combination of stock, specialization and service saves you time and money, *gives you what you want when you want it!*

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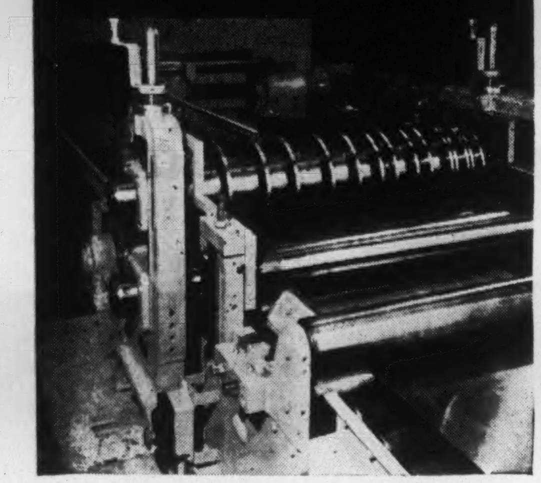

PAY BIG DIVIDENDS WORKING ONLY ONE DAY PER WEEK!

In one plant, two Yoder tube mills and about 50 punch presses are being supplied with slit strands by one Yoder Slitting Line operated an average of only *seven hours per week.*

In another plant, a Yoder slitting line, *operated from six to eight hours per week,* is supplying two intermittently operated roll forming machines with total requirements averaging 100,000 feet per week.

These typical examples demonstrate, first, the big potential output of a relatively small, inexpensive Yoder standardized Slitting Line and, secondly, its big profitability. Assume production of only 35 tons of slit strands per 8 hour shift, one day per week, and the total per year would be 1750 tons. Estimating the saving in slitting cost at only one-half cent per lb., the total annual saving would be $17,500.00.

Besides the big convenience of doing your own slitting, such savings will often repay the investment in a few months.

The Yoder Slitter Book is a comprehensive treatise on slitter operation and economics, with time studies, cost analyses and other useful data. It is yours for the asking.

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For more information, Circle No. 407

PRICES AND SUPPLY

STAINLESS STEEL MILL SHIPMENTS
(Net tons)

Industry	1956	1955
Warehouse	227,465	188,311
Aircraft	33,990	22,379
Machinery, Industrial & Trade	56,936	41,103
Electrical Machinery & Equipment	19,728	8953
Construction & Contractors' Products	22,071	21,566
Automotive	101,487	143,016
Appliances, Utensils & Cutlery	44,413	48,162
Other Domestic & Commercial Equipment	15,315	15,259
TOTAL	687,699	686,449

Source: Committee of Stainless Steel Producers, American Iron and Steel Institute.

were higher in 1956 than in record-breaking 1955. Total mill shipments in 1956 amounted to 687,697 net tons, as compared to 686,449 net tons in 1955.

Several industries showed marked increases over 1955 consumption. The aircraft industry, for example, used 52% more stainless in 1956 than in 1955. In the electrical machinery and equipment industry, the increase amounted to 120%.

Although the figures listed in the accompanying table are accurate, they do not take into consideration the huge amount of steel shipped to warehouses which eventually gets redistributed to each of the market classifications listed. Mill shipments to warehouses increased by 21% over 1955, bringing the total to a whopping 227,465 net tons, or approximately one-third of the total stainless steel shipped by the industry. However, according to a joint report issued by the Committee of Stainless Steel Producers and the American Steel Warehouse Assn., about 8% of the warehouse steel ended up in the automotive and appliance industries; about 13% went to the construction and building maintenance industry; and 67% of the total went to the industrial machinery and equipment industry.

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Cleaning and barrel tumbling are important operational steps. They must rank high in your thinking because they are so important in the overall finishing picture. CLEPO Products have much to offer you in quality and effectiveness; and what is equally important, economy.

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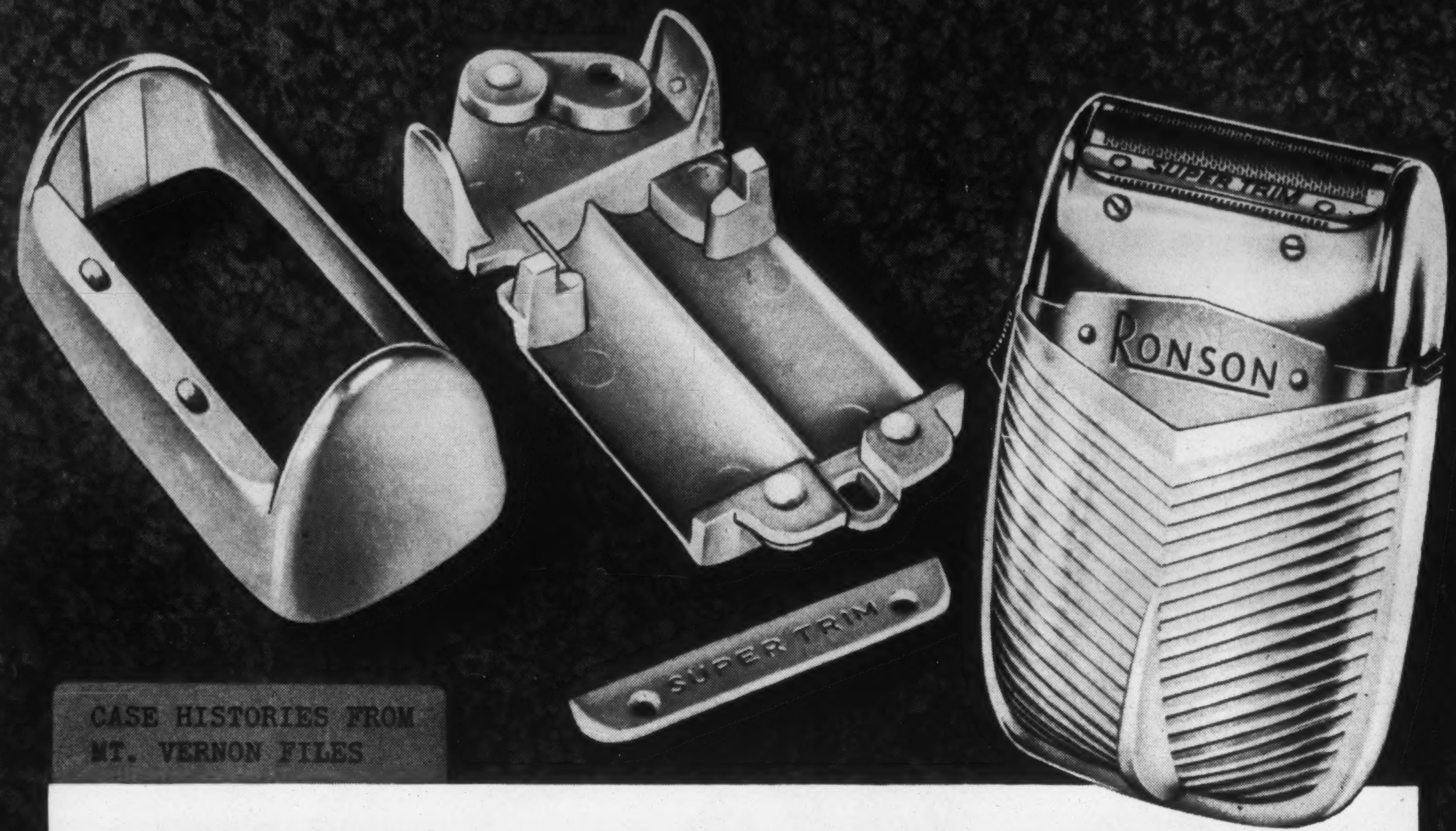

CASE HISTORIES FROM
MT. VERNON FILES

RONSON produces the First Electric Shaver with 2 Separate Cutting Heads

Ronson calls their new "66" Shaver "the most revolutionary electric shaver ever designed"—and offers strong evidence to support this claim. For one thing, it is the first electric shaver with an *extra* cutting head, called "Super Trim", which does every trimming job, from sideburns to mustache.

When any manufacturer is out to break precedent, and still sell his product at a competitive price, he needs every bit of designing and production skill he can find—anywhere.

Ronson found these in generous abundance at Mt. Vernon. Three of the vital parts of the "66"—the head frame and the plate covering the "Super Trim" blades (zinc castings), and the motor chassis (an aluminum casting)—were designed to obtain the special advantages of die casting: thin wall sections of great strength and rigidity, negligible machining, smooth finish, high speed production, low cost.

Says Ronson: "These parts are highly vital to our electric shaver. The cutting mechanism depends on the head frame for its accuracy of mounting and rigidity while cutting. The chassis on which the motor is built is of course the heart of the shaver's power system, and a very accurate casting is necessary for the job."

These advantages, important to any manufacturer, stem directly from the way we are organized here at Mt. Vernon. We have both the facilities and the complete die casting service it takes to produce parts like these, in any quantity, at minimum cost. We have 200,000 square feet of the most modern equipment for making dies and for die casting aluminum and zinc. And Mt. Vernon service comprises completely coordinated designing, die-making, casting, and machining, all under one roof.

It will pay you well to bring your production specifications to us. We may show you, as we did Ronson, the way to important cost reductions and improved products.

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Mr. William Sauers
101 Briarcliff Road, Rochester, N. Y.

Mr. George E. Hahl
39 South Munn Ave., East Orange, N. J.

For more information, turn to Reader Service Card, Circle No. 384

How the right "COAT" solves many spring problems

● Unless you yourself go in for forming wire springs, you have no idea what a tricky business it is. For one thing, as every fabricator knows, it takes extreme uniformity in the wire to obtain the precise dimensions and the exacting tension, torsion or compression characteristics so often required.

But uniformity alone won't always do the trick! As a leading supplier of special wire for tougher-than-usual spring requirements, National-Standard has delved deep into production problems and has come up with answers that help many a fabricator hold better to tough specifications and produce faster with less waste and more profit!

Time and again, for example, National-Standard has shown that merely a change in wire *coating* or lubrication quality is of major importance in forming operations. Proper coating also helps gain uniform dimensional response to heat treating. Quite often, in fact, troubles chalked up to wire variance are really the fault of improper coating or finish.

Helping fabricators solve problems and cut costs is a National-Standard specialty. We're geared for it and make a point of it. Try us and see!

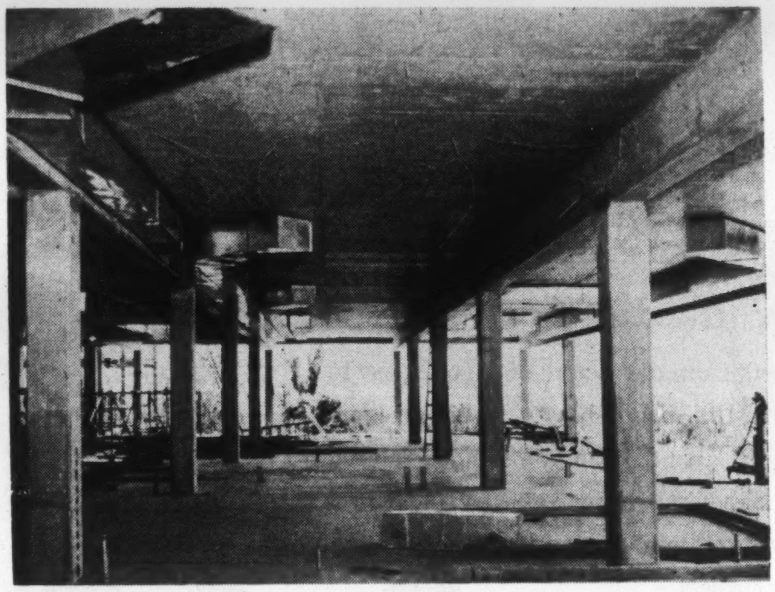
NATIONAL STANDARD

DIVISIONS: NATIONAL-STANDARD, Niles, Mich.; *tire wire, stainless, music spring and plated wires* • **WORCESTER WIRE WORKS, Worcester, Mass.;** *high and low carbon specialty wires*
WAGNER LITHO MACHINERY, Secaucus, N. J.; *metal decorating equipment* • **ATHENIA STEEL, Clifton, N. J.;** *flat, high carbon spring steels* • **REYNOLDS WIRE, Dixon, Ill.;** *industrial wire cloth*

For more information, turn to Reader Service Card, Circle No. 488

News OF INDUSTRY

New research center *has practically 100% plastics exterior, including plastics-faced concrete blocks, sandwich curtain wall panels and acrylic louver-type windows.*



Plastics-coated plywood *forms for setting concrete can be re-used, leave a smooth surface (note ceilings).*

Plastics Get Best Test Yet in New Laboratory

■ A thorough and comprehensive in-service test of plastics as materials of construction is being conducted by Monsanto Chemical Co. at its new research center in St. Louis, Mo.

The research center, a three-story building with about 70,000 sq ft of floor space, incorporates in its construction more than 80 applications of plastics—from a virtually 100% plastics exterior (including an unusual all-plastics panel curtain wall and plastics glazing) through plastics pipe and electrical conduit to plastics laboratory furniture. What makes the construction of this building significant in terms of testing and evaluation of plastics materials is that, unlike Monsanto's "House of Tomorrow," the laboratory utilizes plastics only where "distinct advantage can be obtained." The building is traditional, not futuristic, in concept and, according to Monsanto, is designed to prove that the plastics house is really for today, not tomorrow.

New uses of plastics in the structure include: 1) reinforced polyester-faced concrete blocks for exterior walls. Their cost per sq ft in place in the wall is less than that of a face brick wall and according to Col. H. R. Tumin, project design engineer, these blocks can now be considered a "standard structural commodity." 2) Foamed styrene sandwich panels for roof and other walls. The panels weigh only 70 lb each compared to 300 lb for a metal sandwich panel and they can be easily placed by two men. The 2-in. thick styrene foam core is faced with integrally colored glass-reinforced polyester panels and the insulation furnished is claimed to be equivalent to that furnished by a 16-in.-thick brick wall. 3) Plastics-coated plywood forms for setting concrete. The reduced cement finishing necesary after forms are removed more than offsets the cost of form ma-

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PLASTIC MOLDING
COSTS

high impact styrene
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Benefit from our wealth of experience with all plastics. If you have a design problem, we'll be glad to send you molded samples in the material you are considering. Check below and mail this ad, or write us about your project.

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☐ phenolic
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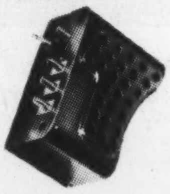

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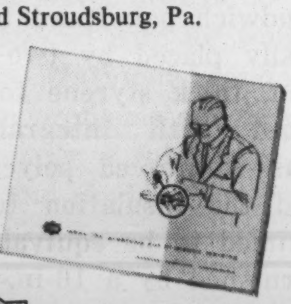
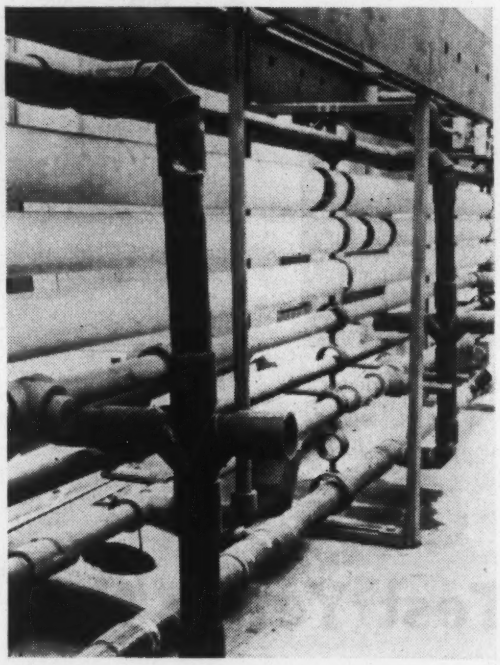


SHAW
SHAW
custom molds all plastics
by TRANSFER • COMPRESSION • INJECTION

For more information, Circle No. 515

News OF INDUSTRY

Acrylic louver-type windows *permit passage of indirect light, filter out direct rays of the sun.*



Piping system *includes six lines made of polyvinyl chloride. Three insulated metal lines carry steam or hot water.*

terial. In addition, they can be re-used.

All of the plastics materials used in the laboratory were given extensive tests. However, the most extensive test the materials will get will be performed by weather, age, atmosphere, etc., and indications are that the materials will come through all right. To Michael F. X. Gigliotti, manager of structural plastics engineering for Monsanto, the building is not an experiment at all but a "full-scale catalogue of available plastics today."

(more News on p 248)

SPARTA
with our
PATENTED PROCESS
for
Custom Molding
in thin sections and
shapes

NAMES MEAN
A LOT - TOO!

TEFLON*
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properties
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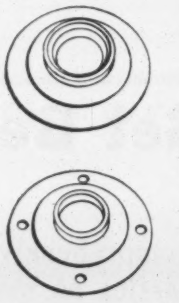

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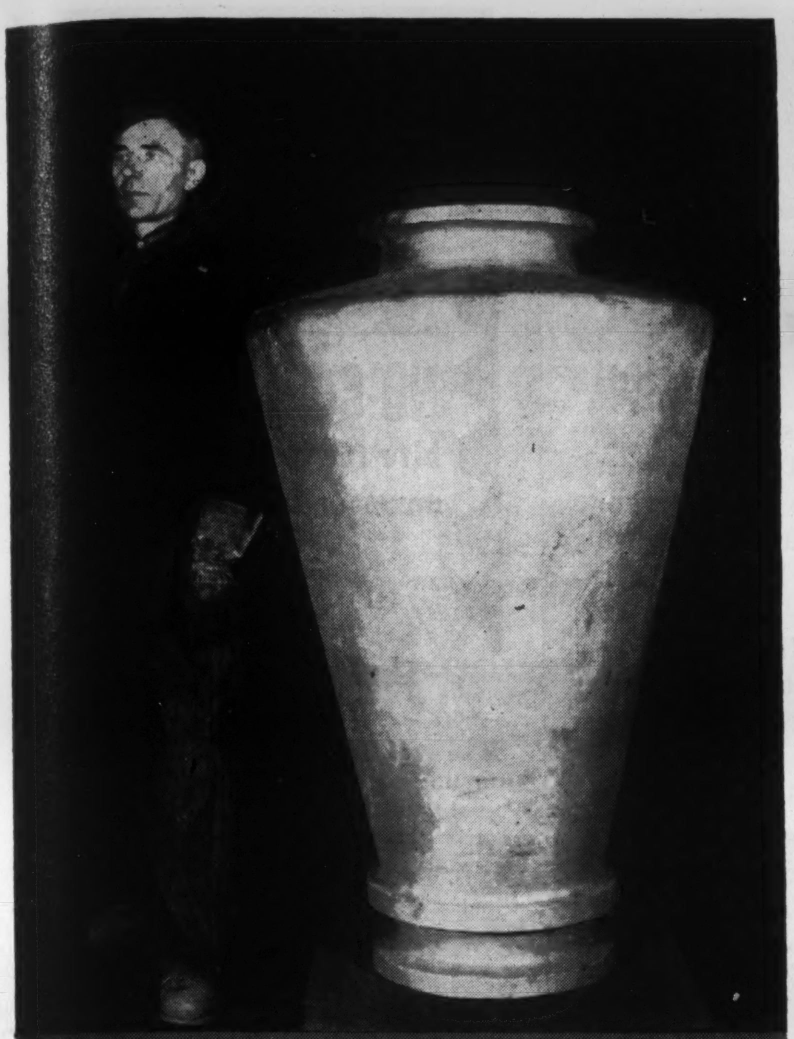

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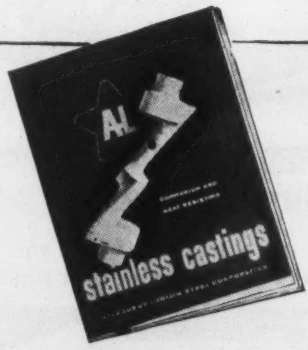
"Our Stainless Castings are Special"

"BIG"–"SPECIAL"–"TINY"–"INTRICATE"...

We can handle any job you have



Write for this book on A-L STAINLESS STEEL CASTINGS

28 pages of valuable and complete data on stainless castings: analyses, properties, technical data on handling and heat treatment, typical applications, how to order, etc.

ADDRESS DEPT. MM-90

Our Buffalo Foundry produces high-alloy steel castings *exclusively* . . . principally for corrosion and heat resisting applications. We've had long and valuable experience (as a pioneer in both vertical-centrifugal and static stainless casting methods) with practically every type of service condition you can name, and we'll welcome the opportunity to take on any stainless, high-temperature or high-strength casting problems you have.

And not just as a matter of meeting the service conditions, either. We're ready to handle any special shape or difficult-to-cast section your job may require . . . and any size of casting from a few ounces to several tons.

- *Let us quote on your requirements.* You'll find Allegheny stainless castings unsurpassed for soundness, clean-grained strength and easy machining qualities. Uniform, too, and reliably true to the "specs" in every particular. *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.*

WSW 6534

Make it BETTER—and LONGER LASTING—with

Allegheny Stainless

A-L ALLEGHENY LUDLUM ®

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For more information, Circle No. 366

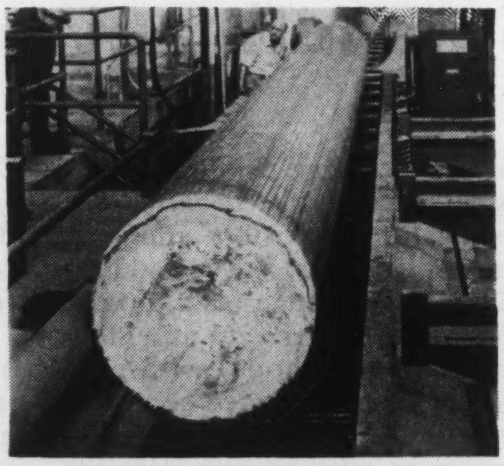
News OF INDUSTRY

Chief of Staff Urges More Metals Research

Further progress in the production of aircraft will necessitate new methods of developing and using new materials capable of withstanding high temperatures and sonic vibration, Lt. General C. S. Irvine, Deputy Chief of Staff, Matériel, stated at a recent meeting of automotive engineers.

General Irvine, in pointing out future needs, said "within the next ten years we must further develop titanium for the 1200 F range. We must develop ductile chromium-base alloys. And further research in the use of beryllium is fast becoming an obvious requirement."

For the needs of the near future, General Irvine declared that "we expect to develop uses of columbium-base alloys in structural parts of nuclear air vehicles. And we anticipate the development of cermets with sufficient



Extrusion billets—This large extrusion billet, cast by Kaiser Aluminum & Chemical Corp. on a semi-continuous basis, is 20 in. in dia and 25 ft long. The casting machines, constructed by Loma Machine Mfg. Co., Inc., are being used to cast such aluminum alloys as 6061, 6062, 2024 and 7075. The alloyed billets are claimed to have excellent metallurgical structures, free from inverse segregation.

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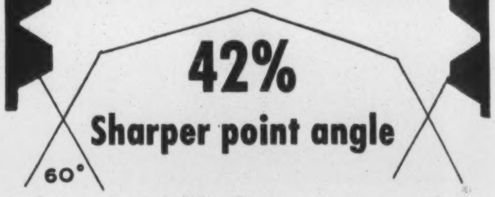
Conventional

NU-CUP*® gives a better bite for greater holding power on small dia. shafts!



Setko exclusive Nu-Cup set screws end shaft slipping on even small shafts. The sharper point . . . 42% sharper than conventional cups . . . takes a better "bite". On small shafts, this gives a full circle impression, greater resistance to reversal with the same setting torque you're now using. And, Nu-Cup set screws are made of alloy steel, specifically heat treated to make higher setting torques possible . . . assurance against screw head cracking.

Automation . . . Setko Nu-Cup set screws can be hopper-fed! The new Setko System for hopper feeding headless set screws will orient and feed Nu-Cup set screws as small as #2 (.086" x 1/8").

Available In Popular Types . . .

Fluted Socket
Hexagon Socket
Slotted Head
Slabbed Head

MAKE THIS NU-CUP* COMPARISON TEST . . . FREE

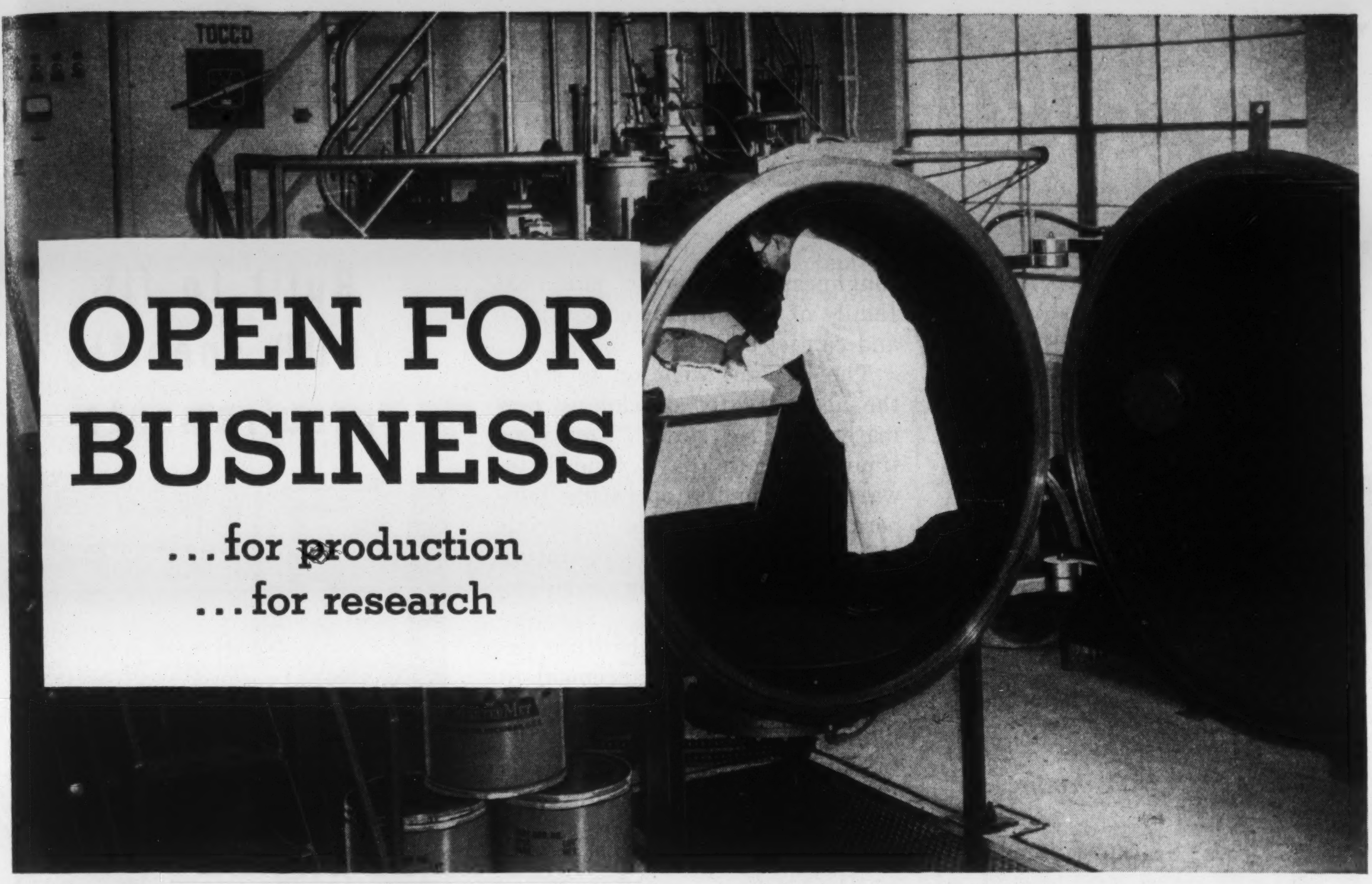
You're under no obligation when you test Nu-Cup's greater holding power for yourself.

Nutcracker Test Tongs with complete instructions and sample Nu-Cup set screws will be loaned on request. Setko will also send a free copy of Catalog 21 with complete details on Nu-Cup set screws, and Setko's new System for hopper feeding headless set screws.

FAST DELIVERY SERVICE . . .
Setko delivers even the most specialized types of set screws promptly. You get exactly what you need, when you need it!
*U. S. Pat. 2,778,265

Set Screw & Mfg. Co.
149 Main Street, Bartlett, Illinois
1581

For more information, Circle No. 434



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...for production

...for research

ULTRAMET ALLOYS are processed at less than 10 microns of vacuum, in this latest design vacuum melting furnace — fully equipped for refining and manipulation of the charge under exact time and temperature controls. Result: super-clean, super-strong metals offering you greater tensile strength, ductility and wear life . . . higher electrical and magnetic properties.

Cannon-Muskegon offers complete vacuum-melting facilities for ferrous, nickel- and cobalt-base alloys

NOW AVAILABLE: stainless, tool and die, magnetic steels—high-temperature, corrosion-resistant, low expansion alloys — bearing steels, and alloys for electrical and electronic applications plus special steels.

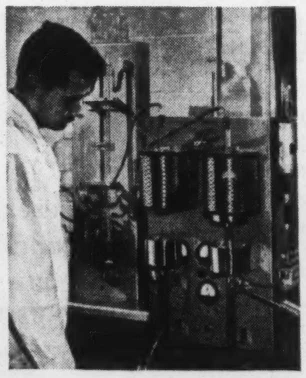
We offer industry:

Materials for remelt and processing—in pounds or tons — under vacuum, conventional air-melting or inert gas processes.

Casting development, including research and experimental facilities for investment, shell mold, dry sand and permanent mold castings.

Ingots, billets and a variety of cast forms — for rolling, forging, extruding or machining.

X-Ray fluorescence spectrometer—the most modern means for rapid and accurate analysis of major elements in alloys — just one of a series of regular evaluations that maintain highest quality control standards.



Precise carbon analysis is another UltraMet test for chemical quality. Additionally, tensile properties, creep tests, Rockwell hardness, bent wire and other tests safeguard perfection throughout production.

MasterMet alloys are produced by air-melting in modern high-frequency furnaces. The chemical analysis of each melt is certified to your specifications — exactly produced to compensate for melting losses.

For full particulars, write for our new bulletin on Vacuum Melting and Air Melting facilities and alloys . . . plus details on new "tight" specs on Armco 17-4PH.

MASTER MET CERTIFIED ALLOYS FOR INDUSTRY

ULTRA MET VACUUM-MELTED ALLOYS FOR INDUSTRY

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METALLURGICAL SPECIALISTS

For more information, turn to Reader Service Card, Circle No. 489

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THE CRAYONS THAT TELL TEMPERATURES

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- **Select appropriate TEMPILSTIK° for the working temperature you want.**
- **Mark your workpiece with it.**
- **The TEMPILSTIK° mark melts as soon as its temperature rating has been reached.**

Accuracy within 1% of rated melting point.

Also available as TEMPILAQ° (liquid form) and TEMPIL° PELLETS

63 different temperature ratings available

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Send information on:
☐ TEMPILSTIK° ☐ TEMPILAQ°
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☐ Send booklet "How Temperatures are Measured"
☐ Send sample pellets for ______°F temperature
Name______
Address______
City______
State______

For more information, Circle No. 433

News OF INDUSTRY

toughness for use in our next family of high performance turbo and ramjet engines."

The General went on to stress the necessity for developing new materials. He said: "For some time designers have tended toward pushing the operating temperatures of available materials above their normal operating limits, then providing auxiliary cooling as a crutch . . . The tendency has been to substitute expediency for real advancement in design." He proposed that designers seriously examine the "possibilities of untried materials . . . For the plain fact is that unless we do advance the art of thermal resistant materials, air vehicle development will lag."

Pilot Plant Combines Theory and Practice

A new pilot plant, unique in that it is equipped to perform complete materials research from mineral beneficiation and ore-dressing to forging and casting, has been opened by Vanadium Corp. of America.

Designed to combine laboratory research with practical operating conditions, the pilot plant is equipped with such facilities as forging hammers, smelting and melting furnaces, heat treating equipment, molding and casting equipment and others. One of the research programs is aimed at trying to discover useful by-products from industrial wastes.

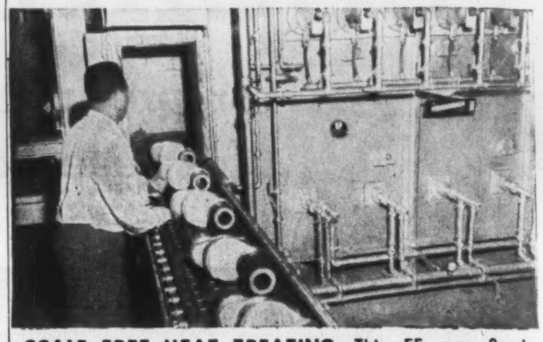
Actual Flight Conditions Simulated in New Lab

A device for realistically testing aircraft and missiles in airflows of 10,000 mph and temperatures of 9000 F for times greater than previously possible is being

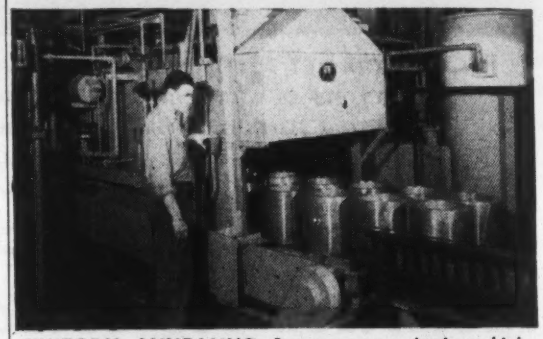
(continued on p 255)

EF FURNACES

Built to fit YOUR specific requirements



SCALE FREE HEAT TREATING. This EF gas fired radiant tube installation with 3 heating zones, elevator type oil quench and a 2-station washing machine and rinsing equipment, scale free hardens heavy aircraft motor parts, uniformly, automatically and continuously.



UNIFORM ANNEALING. Brass, copper, aluminum, high and low carbon, stainless and other alloy strip, tubing and wire in coils, on reels or in strands, are uniformly annealed in hundreds of EF continuous and batch type furnaces. Our extensive experience can save you time and money.

BRIGHT ANNEALING. Discharge end of an EF gas fired radiant tube installation with EF endothermic special atmosphere generator for bright annealing various sizes of stampings, uniformly and continuously. Other EF installations are handling stainless steel and other stampings.

BULLETIN No. 461 shows typical installations of EF Gas-fired, Oil-fired and Electric Furnaces *Send for a copy today!*

THE ELECTRIC FURNACE CO.
Salem - Ohio
GAS-FIRED, OIL-FIRED AND ELECTRIC FURNACES FOR ANY PROCESS, PRODUCT OR PRODUCTION

Canadian Associates
CANEFCO LIMITED • Toronto 1, Canada

developed at Cornell Aeronautical Laboratory.

The most significant feature of the new research facility is its ability to operate at the extreme temperatures and speeds for periods of 15 sec and longer. Although test devices producing the temperature and airflow characteristics of hypersonic flight (five times the speed of sound) are currently in operation, they can produce these temperatures and speeds only for brief periods—generally a few thousandths of a second. Although these brief test times enable scientists to study certain flight characteristics of shapes in hypersonic flow, the test duration is so short that the materials and structures of the test models are only slightly affected by the extreme temperatures generated. Actual flight at hypersonic speeds produces temperatures which will melt or wilt conventional metals. With the new facility, Cornell scientists hope to attack this vital problem by subjecting models to hypersonic airflows and temperatures for long enough periods to permit studying the effect of the extreme temperatures on the model's materials and structures.

The new device will employ air as the test gas, enabling the laboratory accurately to simulate actual flight in the earth's atmosphere. The heart of the new test facility is the "wave superheater." It is essentially an arrangement of tubes capable of producing a continuous flow of high speed, high temperature air. It operates at temperatures beyond the melting point of known materials.

(news of Engineers on p 256)

FASTEST SERVICE...
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ENGINEERED BRONZE BEARINGS
BUSHINGS
WEARING PARTS

Sound quality castings of any size, shape or section, rough cast or machine to precisely controlled tolerances. Difficult oil grooving... smooth even around acute bends.

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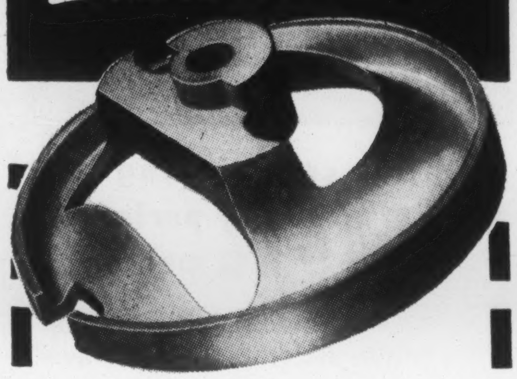
For more information, turn to Reader Service Card, Circle No. 529

Cam Milling and Contour Machining Eliminated!



This EpCo INVESTMENT CASTING Proves the Point

PART: Cam for Aircraft Instrument

MATERIAL: Stainless Steel, 440

PROBLEM: To reduce time and cost involved in setting up and performing 8 different types of machining operations.

SOLUTION: An EPCO Investment Casting Completely dispensed with
1. Cut-off
2. Turning O.D.
3. Center Hole Drilling
4. Form Turning
5. Form Milling
6. Contour Milling
7. Slot Milling
8. Cam Milling

Leaving only cam polishing, bottom grinding and hole reaming.

CONCLUSION: Intricate Machine Parts by redesigning to EPCO Investment Casting tolerances can be made to give better performance at far less cost.

Send us drawings, samples and specification of parts for detailed process analysis and cost quotation without cost or obligation.

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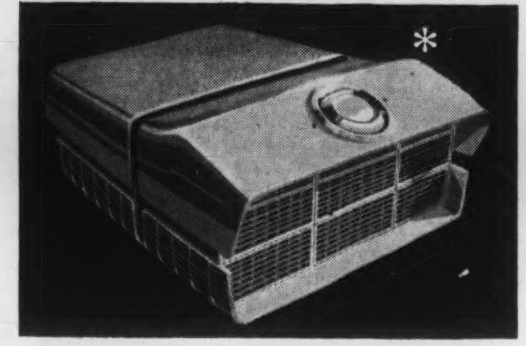
Idea!

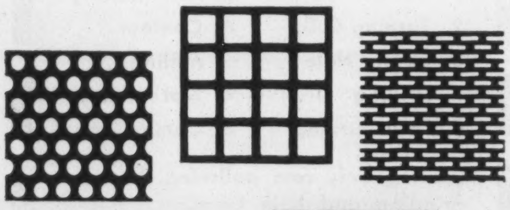


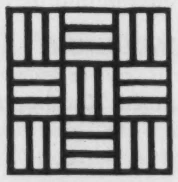
room air conditioning unit using H & K perforated metals

In the ¾ ton window air conditioner illustrated, perforated metals have been combined successfully with injection moulded plastics. The utilization, here, of new louvered perforated metals in adjustable frames on the frounced surface in combination with new embossed patterns on sides and under surfaces, afford rich tactile qualities hitherto unattainable in the air conditioner field.

Harrington & King perforated metals provide the Industrial Designer and other men of ideas unlimited opportunities to offer both functional and aesthetic properties as demanded in products for today's market. Contact H & K for your perforating requirements.

*Product Development by William M. Schmidt Associates





A few of the thousands of H & K perforated patterns. Illustrations are reduced in size.

Fill in and mail coupon to nearest H & K office.

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☐ GENERAL CATALOG NO. 62

☐ STOCK LIST of Perforated Steel Sheets

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COMPANY__________

STREET__________

CITY______ ZONE______ STATE______

For more information, Circle No. 446

News OF INDUSTRY

Engineers

Arthur W. Weber is now vice-president of Corning Glass Works.

Jay J. Newman has been appointed manager, new product and market development, RCA Components Div., Radio Corp. of America.

Lt. Alan Q. Eschenroeder, ordnance engineer, Army Ballistic Research Laboratories, has been awarded the Hannibal C. Ford Fellowship for advanced engineering study at Cornell University.

E. P. Hansen has been promoted to assistant chief engineer of Allis-Chalmers' Steam Turbine Dept. He succeeds **H. D. Emmert,** recently named chief engineer.

Nathaniel Brewer is now vice-president in charge of technology at Fischer & Porter Co. **Alexander Greenfield** replaces Mr. Brewer as director of research, development and engineering.

Sam Philips has been appointed applications engineer, J. B. Rea Co.

William H. Grumet takes over as manager, American Laboratories, a new division of American Electronics, Inc.

Roy E. Fountain has been appointed engineer-advanced value research, manufacturing services, General Electric Co.

John P. Malbrain recently joined Electronic Instrumentation Div., Ramo-Woolridge Corp.

Companies

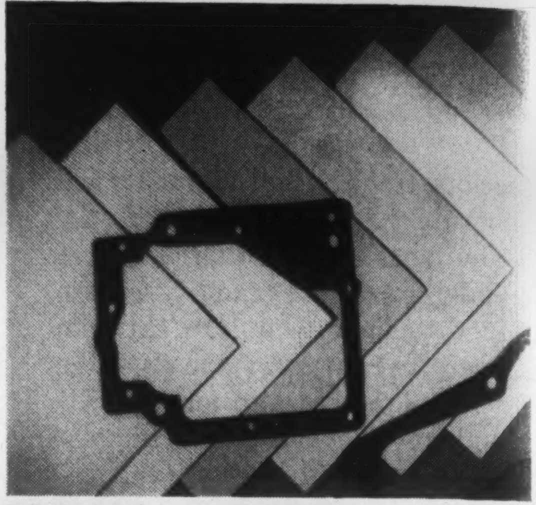
Polymer Corp. is now operating a custom coating plant in Santa Ana, Calif.

Lancaster Glass Corp. is the new name of **Lancaster Lens Co.** The change followed recent acquisition of the Indiana Glass Co.

Northrop International, a recently established division of Northrop Aircraft, Inc., is responsible for all overseas programs.

(continued on p 258)

CHR *Silicone Rubber* **NEWS**



NEW...CHR fuel resistant silicone rubber COATED FABRICS

Jet fuel, hydraulic and synthetic oil resistance; —85°F to 480°F range.

CHR has added "LS-53"[1] coated glass, "Dacron" and nylon fabrics to their line of COHRlastic® Coated Fabrics.

The new "LS-53" coated fabrics provide vapor, splash and immersion resistance to fuels, hydraulic and synthetic oils over a temperature range of —85°F to 480°F, depending upon base fabric. Supplied on custom basis initially, CHR's "LS-53" coated fabrics provide the most economical use of this new, high performance elastomer.

Many other silicone rubber coated glass, "Dacron," Orlon and Nylon fabrics (for —125°F to 600°F applications other than fuel resistance) are *available from stock* or can be made to order. We will also custom design fabrics to meet specific requirements.

CHR supplies both coated fabrics and finished assemblies made from these fabrics such as actuator boots, aileron curtains, radomes, fuel cells, conveyor belts, arctic covers, fuel and fire barriers, and gaskets.

Write for bulletin describing both "LS-53" and regular silicone rubber coated fabrics.

[1] *Dow-Corning's new fuel resistant fluorosilicone rubber.*

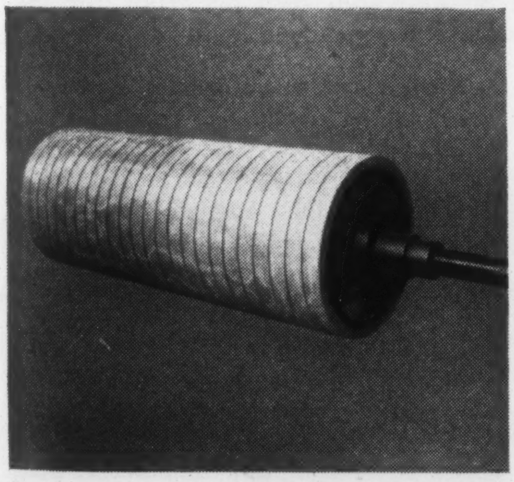
CHR
SEALS • COATED FABRICS
DE-ICING, ANTI-ICING AND HEATER ASSEMBLIES
SILICONE RUBBER PRODUCTS

THE **CONNECTICUT HARD RUBBER** CO.
407 EAST STREET • NEW HAVEN 9 • CONN.

For more information, Circle No. 443

before
pan
or
can...

Synthane laminated plastics are at work



Synthane-covered tin plate rolls last three times as long as other materials because of resistance to acids and surface toughness.

Few industries escape the multiple benefits of Synthane laminated plastics. The food industry puts Synthane to work as star wheels for bottling equipment, bread slicing guides, as oil-less bearings in processing of sugar syrups and even in the tin-plating operation of metal containers.

Resistance to moisture, anti-friction characteristics, chemical and wear resistance are but a few of the reasons why Synthane is at work in this vital industry.

Synthane laminates combine in varying degrees—depending on which of the 30 or more grades you use—many mechanical, electrical and chemical properties hard to find combined in any other material.

You can buy Synthane in sheets, rods, tubes. If you prefer, your part can be supplied fabricated to your specifications. Send for our complete catalog for full information.

Synthane Corporation, 3 River Road, Oaks, Pa.

EASILY MACHINED

DIELECTRIC STRENGTH

CHEMICAL RESISTANCE

WEAR RESISTANCE

SYNTHANE S . . . industry's unseen essential.

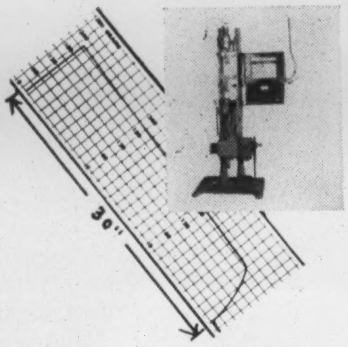
SYNTHANE CORPORATION, 3 RIVER ROAD, OAKS, PA.

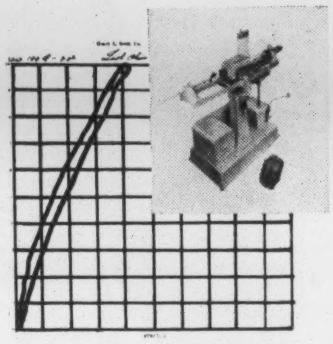
For more information, turn to Reader Service Card, Circle No. 502

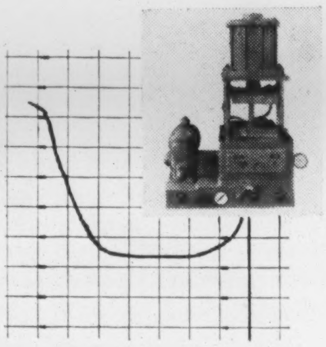
For more information, turn to Reader Service Card, Circle No. 520

"Picturized" Testing with SCOTT TESTERS* –

Your Key to Quality Control of Materials, Processing, Fabrication







"ACCR - O - METER." This versatile electric weighing tester provides unbelievably accurate (to 0.25%) "picturized" graphs of material under test: textiles, rubber, plastics, wire, paper, lamination bond, etc.

TENSILE - HYSTERESIS. Incline-plane constant-rate-of-load machine tests plastic film, metal strip, rubber, paper, foil, wire, cords, etc. up to 50 lbs. tensile.

STI MOONEY. Successor to world-standard NBS Mooney. Greatly increases convenience and speed of operation. Only Scott Mooneys conform to ASTM methods of determining VISCOSITY, SCORCH and CURE.

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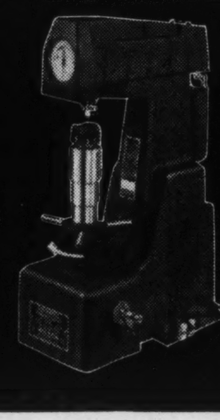
State Your Testing Problem and let our 58 years experience assist you.

SCOTT TESTERS, INC. 65 Blackstone St. Providence, R. I.

Scott Testers – Standard of the World

WILSON "ROCKWELL"—
THE WORLD'S STANDARD OF HARDNESS TESTING ACCURACY

WILSON "ROCKWELL"
HARDNESS TESTERS



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Sensitive and Accurate as a precision balance —the WILSON "Rockwell" hardness tester insures the quality of your products and protects your good name as a manufacturer.

Durable as a machine tool—WILSON "Rockwell" hardness testers withstand severe daily use with a minimum of service requirements.

A staff of WILSON hardness testing experts is available to help choose the model best suited to your job—and provide quick emergency service if it is ever needed.

A FULL WILSON LINE TO MEET EVERY HARDNESS TESTING REQUIREMENT

FULLY AUTOMATIC
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For more information, turn to Reader Service Card, Circle No. 413

News OF INDUSTRY

Sterling Die Div., Pratt & Whitney Co., Inc. is operating in a new plant with more than three times its former manufacturing facilities.

Vacuum Film Products, El Segundo, Calif., is a new electronic components division of Servomechanisms, Inc.

Naugatuck Chemical Div. of U. S. Rubber Co. is constructing a new plant in the Baton Rouge area that will triple the company's production capacity of plastics and synthetic rubber. In New Jersey, U. S. Rubber has transferred all Passaic laboratories personnel and operations to a new research center at Wayne.

Fiber Glass Industries, Inc., a new organization located in Amsterdam, N. Y., has purchased the fiberglass and reinforced plastics operations of Bigelow-Sanford Carpet Co., Inc.

H. B. Fuller Co.'s new St. Paul, Minn., plant houses production, office and laboratory testing facilities.

Dittbrenner Associates, Inc., Rockaway, N. J., is a newly formed company in the specialty coatings field.

Republic Steel Corp. and **National Lead Co.** have formed the jointly owned **R-N Corp.** to provide high metallic iron feed materials for the metallurgical field.

Sel-Rex Corp. has taken a long term lease on a 40,000-sq-ft building in Nutley, N. J.

Borden Co. has opened its second formaldehyde and resins plant in Fayetteville, N. C. The Chemical Div. has acquired the **Lawrence Process Co., Inc.,** which will be operated as a wholly-owned Borden subsidiary.

Metals Research and Development, Inc., a new company in Exeter, Pa., is operating a laboratory and consulting service.

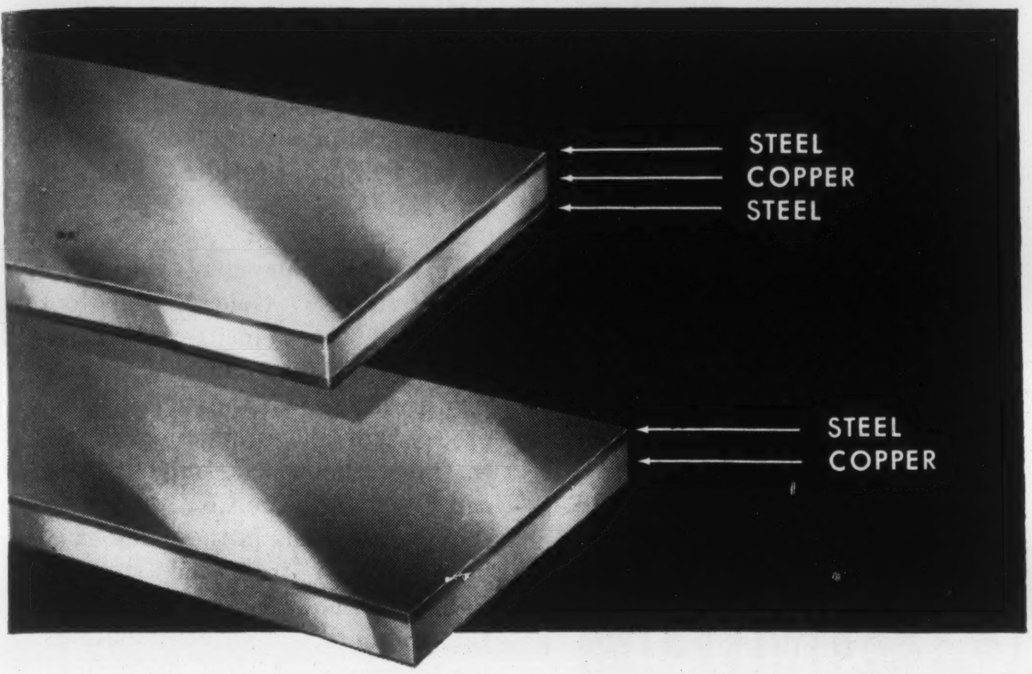
Chromalloy Corp. has purchased **Elyria Foundry Co.** The foundry will operate as a division of Chromalloy with no change in operation or management.

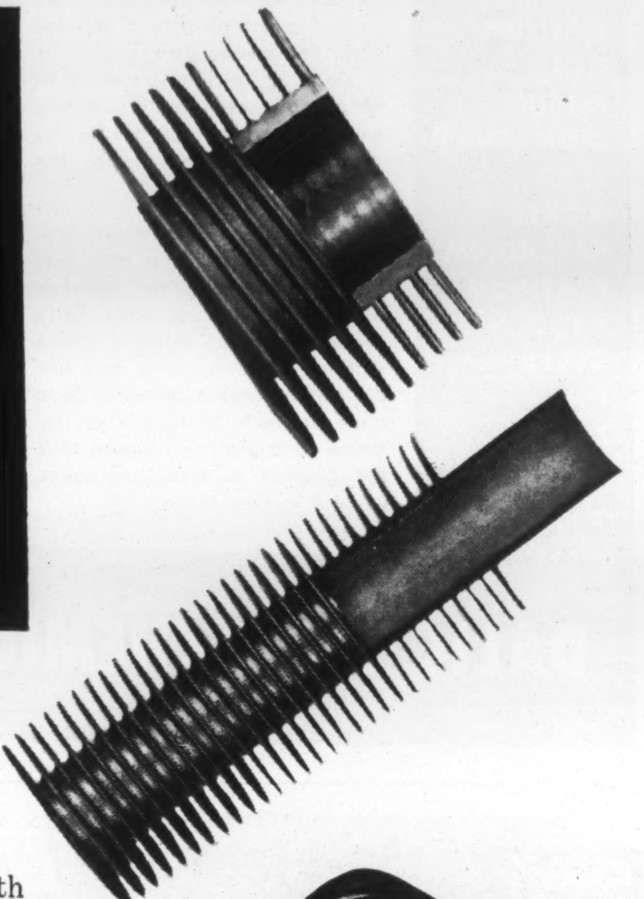
Lamb Electric Co., formerly a wholly-owned subsidiary, is now a division of **American Machine and Metals, Inc.**

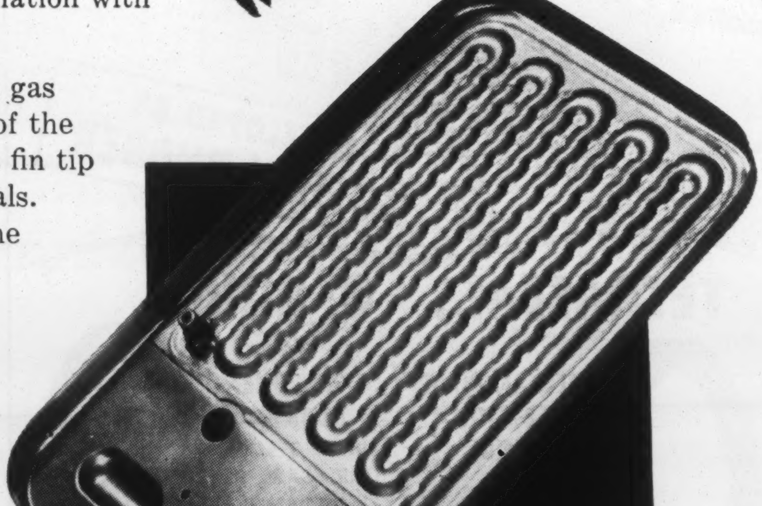
(news of Societies on p 260)

General Plate's

Stainless Clad Copper Combines Desirable Properties of Copper and Stainless To Offer New Advantages







When two or more metals are clad into sheet, desirable properties of each are combined to produce a material having new and useful characteristics not present in either metal separately.

Thus General Plate's Stainless Clad Copper offers the superior thermal and electrical conductivity of pure copper in combination with the high temperature corrosion resistance of stainless steel.

For example, in finned heat exchangers designed to work in gas temperatures up to 2600°F, the high thermal conductivity of the copper core in General Plate Stainless Clad Copper reduces fin tip temperatures by 20% to 30% compared to solid fin materials. There is a corresponding increase in fin efficiency, and at the same time the austenitic stainless steel cladding gives the fins substantially greater oxidation resistance, greatly increasing their life.

General Plate Stainless Clad Copper is available in widths up to 13″ and thicknesses up to 1/16″, single or double clad, in long lengths. It can be blanked, drawn, spun, formed, brazed, and spot or seam welded.

Typical products made from General Plate Stainless Clad Copper

Let us send you complete information on General Plate Stainless Clad Copper . . . it may be just what you have been looking for. Write today for Catalog Sheet 727C — no obligation.

METALS & CONTROLS CORPORATION
General Plate Division
1606 Forest Street, Attleboro, Mass.

For more information, turn to Reader Service Card, Circle No. 553

For more information, turn to Reader Service Card, Circle No. 495

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Solutions for:
BISMUTH
BRASS
CADMIUM
CHROMIUM
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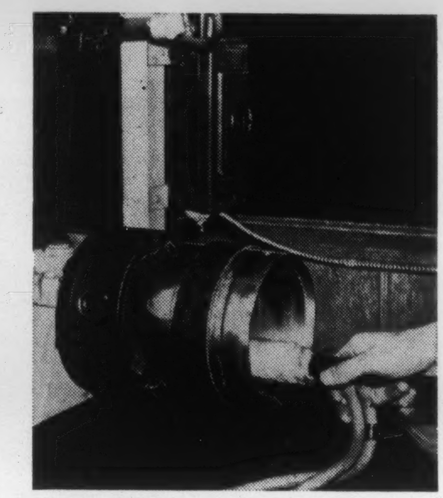
GOLD
INDIUM
IRON (PURE)
LEAD
NICKEL
PALLADIUM
PLATINUM
RHODIUM
SILVER
TIN
ZINC
and a wide range of alloys

Reclaiming A Diesel Bearing

Dalic is an electro-deposition process with an accurately controlled and high rate of deposition. The anode pad, soaked in a cleaning, pickling, plating or stripping solution is moved evenly over the surface to be plated, which is made the cathode.

Deposits have low stress, extremely fine grain, perfect adhesion and complete absence of porosity. Dalic is particularly suited to plating selected areas without masking, parts that are difficult of access or which it is undesirable to dismantle or immerse in a plating solution and for plating to fine tolerances without further machining.



Re-depositing the tin/lead alloy on a diesel bearing (operating time 3 minutes).

DALIC METACHEMICAL LIMITED
121 JUDGE ROAD TORONTO CANADA

Specify JOB-RIGHT SEALING DEVELOPED BY GOSHEN RUBBER

TETRASEALS

RECTANGULAR SECTION RINGS

High performance, economical static seals, TETRASEALS are equal in quality to, and interchangeable with, standard O-rings. Available in natural, synthetic and silicone compounds to meet MIL, AMS, SAE, ASTM and industrial specifications.

O-RINGS *of* SILICONE RUBBERS HAVING SAME SHRINKAGE AS ORGANIC RUBBERS

Now, dimensions and tolerances of AN, MS, SAE, JIC and NAS met consistently with standard tooling from compounds useful over a temperature range of —80°F to +500°F. Nontoxic, too. Lower unit costs, fewer rejects, faster delivery, are other advantages.

For more details, ask for free literature on TETRASEALS and O-RINGS.

other EXCLUSIVE *Goshen Rubber* DEVELOPMENTS

GORSYN

Synthetic rubbers (not silicones) that remain flexible in temperature ranges of —65°F to +300°F; and —20°F to +400°F.

GORSIL

Silicone rubber compounds for molded, lathe-cut and metal-bonded products that must withstand —100°F to +500°F temperatures.

GORLUBE

Low-friction treatment, for O-rings and parts made of natural, synthetic, and silicone rubbers.

GORBOND

Process for securely bonding rubber parts to metals of most every kind.

See our catalog in Sweet's Product Design File.

Goshen Rubber Co. INC.
CUSTOM DEVELOPMENT AND FABRICATION SINCE 1916
3167 S. Tenth St. • Goshen, Ind.

For more information, turn to Reader Service Card, Circle No. 449

News OF INDUSTRY

Societies

American Society of Tool Engineers re-elected 13 members of its 1957-58 board of directors. Two new members of the board are Edward Hollingsworth, president, Tools, Inc., and Frank F. Ford, president, F. F. Ford Associates.

American Foundrymen's Society presented its 1957 Gold Medals to the following three men: Johannes C. Croning, Croning and Co., Germany, for invention of the shell molding process for the production of metal castings; Charles C. Donoho, American Cast Iron Pipe Co., for outstanding contributions in the fields of gray iron, nodular iron and steel; and Clyde A. Sanders, American Colloid Co., for outstanding contributions in the development and dissemination of fundamental data concerning the use of foundry molding sands.

AFS also elected the following 1957-58 officers: president, Harry W. Dietert, Harry W. Dietert Co.; and vice-president, L. H. Durdin, Dixie Bronze Co. National directors are: Henry G. Stenberg, Draper Corp.; A. A. Hochrein, Federated Metals Div., American Smelting & Refining Co.; William D. Dunn, Oberdorfer Foundries, Inc.; Fred J. Pfarr, Lake City Malleable Co.; Karl L. Landgrebe, Jr., Wheland Co.; John H. Russo, Russo Foundry Equipment Co.; and Allen M. Slichter, Pelton Steel Castings Co. Charles E. Drury, General Motors Corp., was appointed to the board of directors.

American Institute of Mining, Metallurgical, and Petroleum Engineers has elected Charles R. Dodson treasurer and controller for one year.

Cobalt Development Institute is a new technical and scientific organization composed of the world's major cobalt producers. Its object: "to improve the existing uses of cobalt and to develop new ones." The Belgian company, Centre d'Information du Cobalt, which will execute the Institute's program, is represented in the United States by the Cobalt Information Center, Battelle Memorial Institute.

(news of Meetings on p 262)

SQUASHED!

Photograph courtesy of Inland Steel Company.

...but not a bit of damage to the galvanized surface

The Reason? A durable, unbreakable bond between steel and zinc, coupled with an exceptional ductility of coating obtainable only when the continuous galvanizing process is used.

The Zinc? Not just any zinc is suitable for the continuous process. It calls for a metal with certain desirable alloying elements, not merely under permissible maximums but within specified maximums and minimums.

St. Joe's contribution to the rapidly growing *continuous* galvanizing output is to match the demands for this special zinc by a corresponding increase in the output of St. Joe Electrothermic Zinc...the Zinc that is used to galvanize sheet or strip that is to be subjected to severe deformation as severe as that illustrated or worse.

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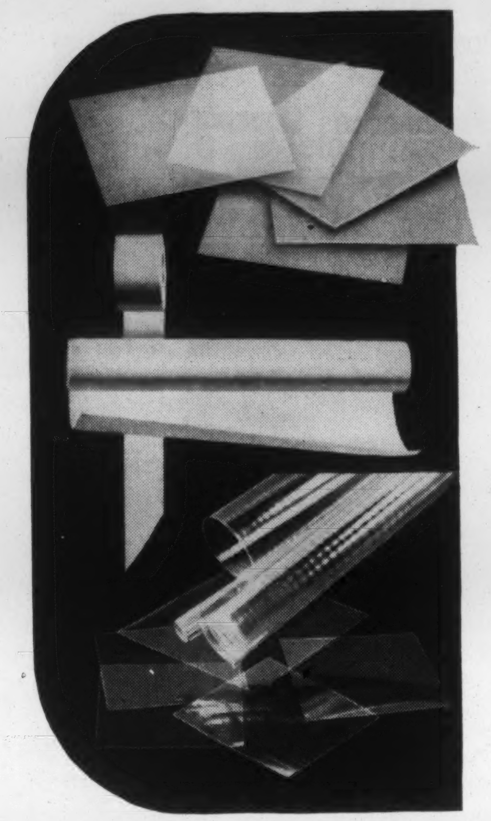

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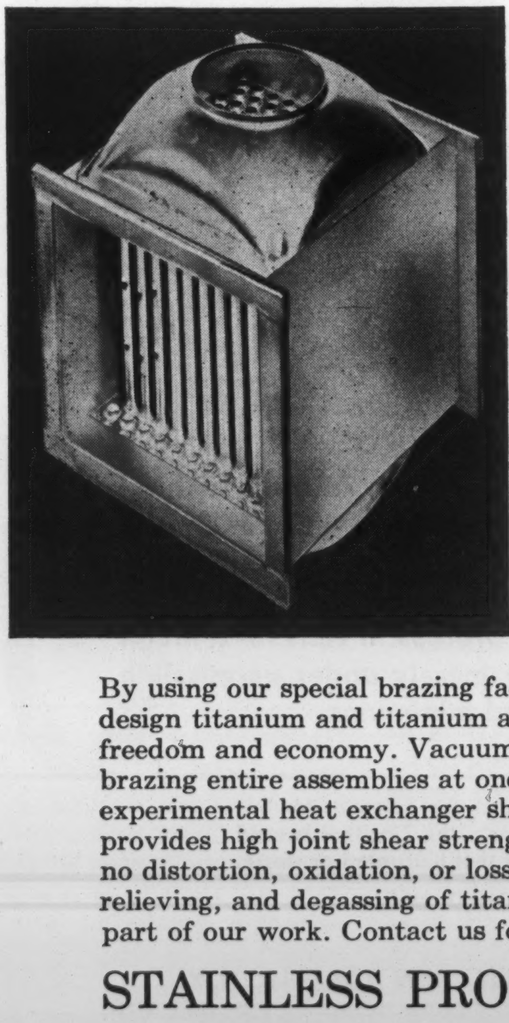

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News OF INDUSTRY

Meetings

SOCIETY OF AUTOMOTIVE ENGINEERS, summer meeting. Atlantic City. June 2-7.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, semiannual meeting. San Francisco. June 9-14.

MAGNESIUM ASSN., annual meeting. Hot Springs, Va. June 10-11.

MALLEABLE FOUNDERS' SOCIETY, annual meeting. Colorado Springs. June 13-14.

SOCIETY OF THE PLASTICS INDUSTRY, Midwest conference. Hot Springs National Park, Ark. June 13-14.

SOCIETY OF PLASTICS ENGINEERS, first annual regional technical conference. Lowell, Mass. June 14.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting. Atlantic City. June 16-21.

AMERICAN ELECTROPLATERS' SOCIETY, annual convention. Montreal. June 17-20.

AMERICAN SOCIETY FOR ENGINEERING EDUCATION, annual meeting. Cornell University, Ithaca, N. Y. June 17-21.

ALLOY CASTING INSTITUTE, annual meeting. Hot Springs, Va. June 23-25.

AMERICAN SOCIETY OF HEATING AND AIR CONDITIONING ENGINEERS, semiannual meeting. Quebec. June 24-26.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, summer general meeting. Montreal. June 24-28.

SOCIETY OF AUTOMOTIVE ENGINEERS, West Coast meeting. Seattle. Aug 12-14.

WESTERN ELECTRONIC SHOW AND CONVENTION, San Francisco. Aug 20-23.

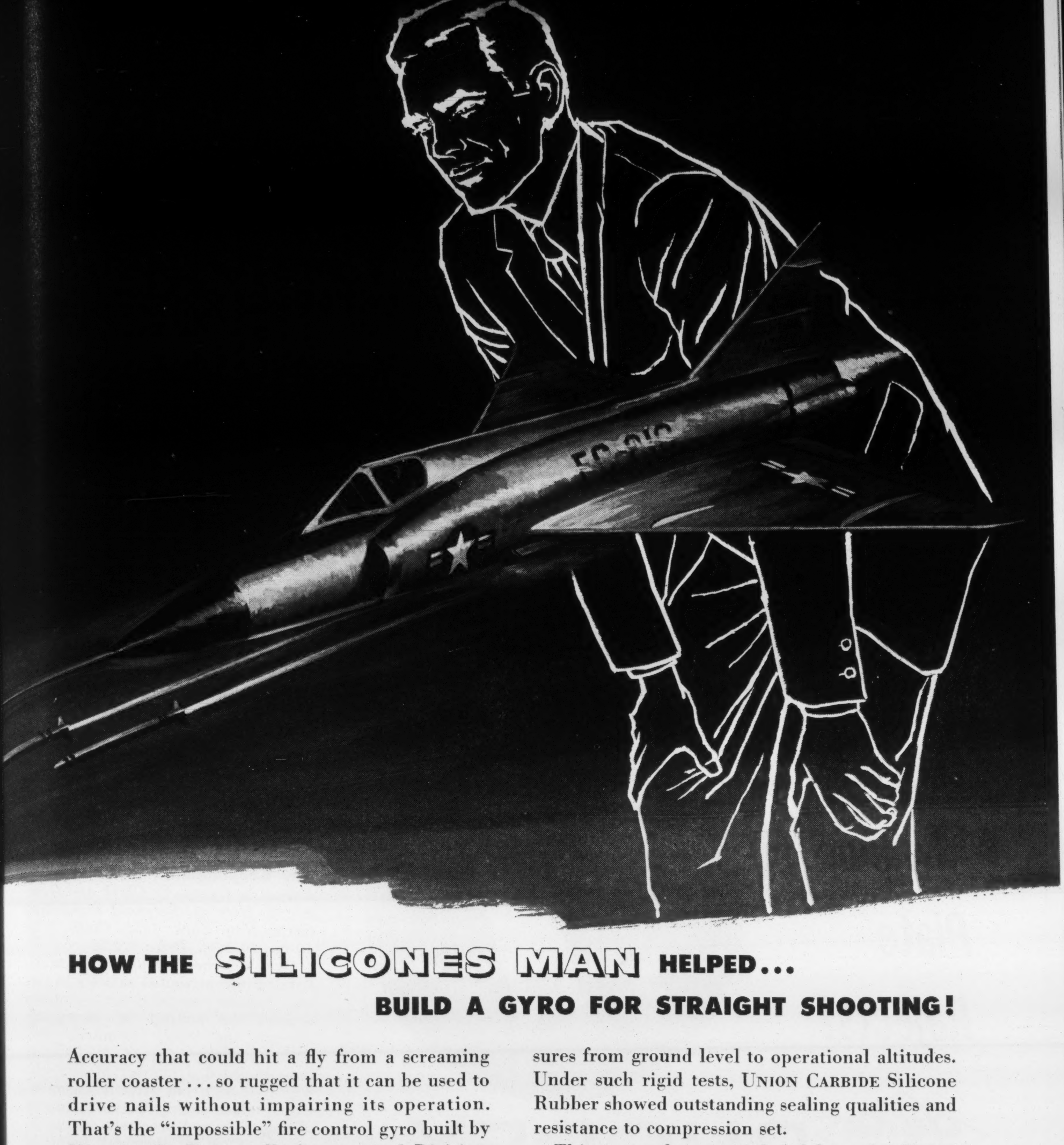
SOCIETY OF AUTOMOTIVE ENGINEERS, tractor meeting and production forum. Milwaukee. Sept 9-12.

AMERICAN DIE CASTING INSTITUTE, annual meeting. Chicago. Sept 17-20.

METAL POWDER ASSN., fall meeting. Pocono, Pa. Sept 20-21.

STEEL FOUNDERS' SOCIETY OF AMERICA, fall meeting. Hot Springs, Va. Sept 23-24.

For more information, Circle No. 509 ➤



HOW THE SILICONES MAN HELPED...
BUILD A GYRO FOR STRAIGHT SHOOTING!

Accuracy that could hit a fly from a screaming roller coaster . . . so rugged that it can be used to drive nails without impairing its operation. That's the "impossible" fire control gyro built by Minneapolis Honeywell, Aeronautical Division. Known as the HIG-5 (Hermetic Integrating Gyro), lightweight and small enough to hold in the palm of your hand, it supplies the "sense of balance" necessary at supersonic speeds.

Operating in a viscous fluid under wide limits of temperature and pressure, seals can be no less than perfect. What material was used? "O" rings of UNION CARBIDE Silicone Rubber.

Fabricated by Moxness Products Company, Racine, Wisconsin, these "O" rings were tested from −65 to +200 deg. F., at simulated pressures from ground level to operational altitudes. Under such rigid tests, UNION CARBIDE Silicone Rubber showed outstanding sealing qualities and resistance to compression set.

This is another example of how the UNION CARBIDE Silicones Man has helped solve an "impossible" problem. A booklet—"Look to UNION CARBIDE for Silicones"—describes silicone rubber and many other silicone products. Write Dept. N-6 today. Silicones Division, Union Carbide Corporation, 30 East 42nd Street, N. Y. 17, N. Y.

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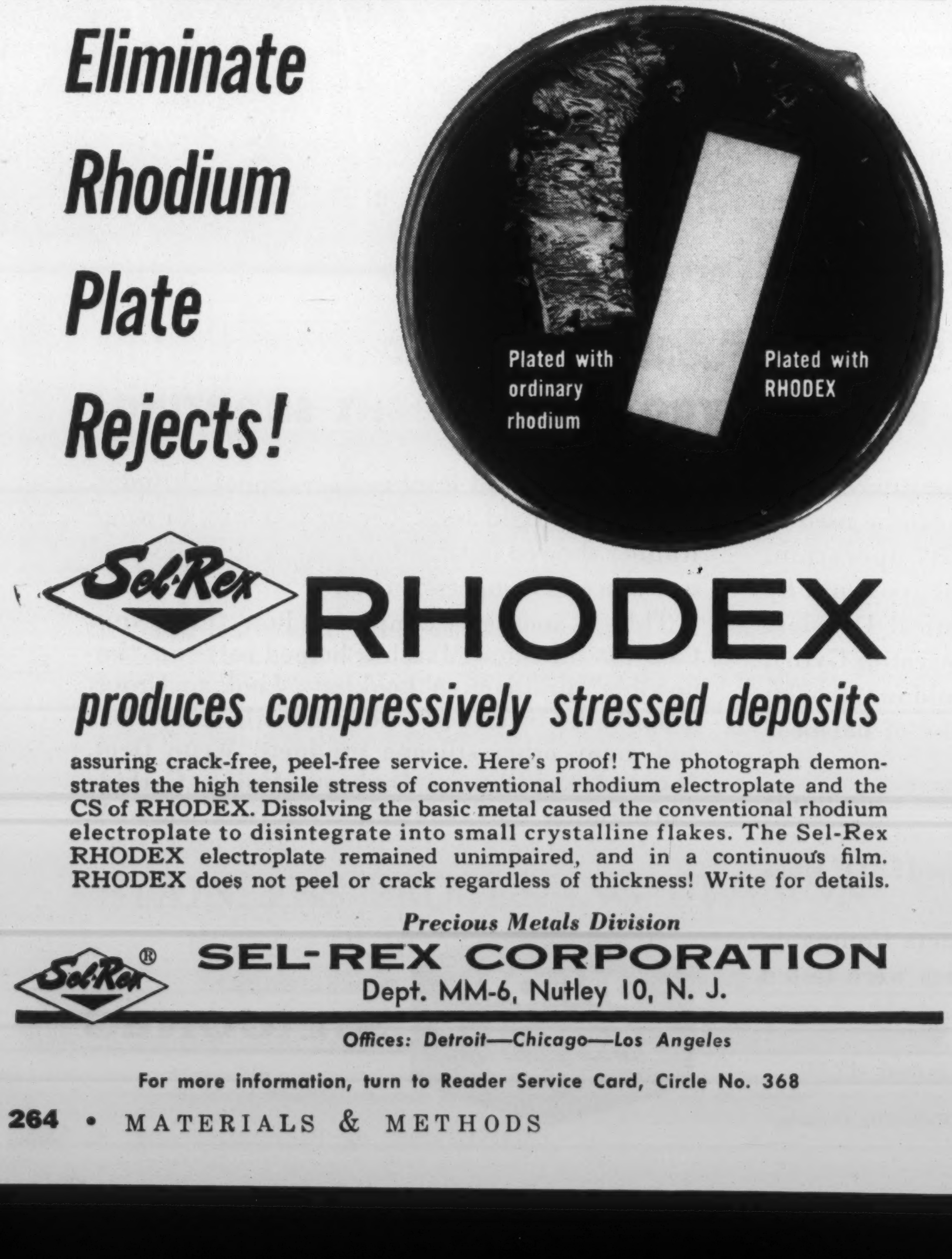
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BOOKS & REPORTS

Books

Quality Control for Plastics Engineers. *Edited by Lawrence M. Debing. Reinhold Publishing Corp., New York. 1957. Cloth, 6 by 9½ in., 142 pp. Price $4.95*

Using the theme "quality cannot be inspected into a product; it must be built in," the ten papers presented in this volume attempt to show that the more adequately plastics manufacturing processes are controlled, the less is the likelihood of scrap and rejects in making plastics parts. Authored by experts in the field of statistical quality control, the papers cite examples of statistical quality control techniques currently used in the industry; these include control charts, sampling, process capability studies, correlation and experimental design. The application of these methods to plastics manufacturing has been simplified to such an extent that a person with ordinary high school mathematics can use them.

The Encyclopedia of Chemistry. *Edited by George L. Clark and Gessner G. Hawley. Reinhold Publishing Corp., New York. 1957. Cloth, 7 by 10 in., 1053 pp. Price $19.50*

Over 500 chemists and allied scientists have contributed articles to this one volume encyclopedia centered around the subject of chemistry. Though the topics primarily deal with chemistry proper, the editors have included a number of subjects, which, though not strictly chemical, either relate closely to the chemistry of materials and processes, or can be treated from a chemical point of view. Topics include atomic power, automatic control, electron tubes, radioactivity, new elements, plastics, metals, air pollution, safety, packaging and hundreds of similar topics.

Steel Structures Painting Manual: Volumes One and Two. *Edited by Joseph Bigos. Steel Structures Painting Council, Pittsburgh, Pa. Cloth, 8½ by 11 in. Price $6.00 each*

Volume I, Good Painting Practice. 1954. 430 pp. Describes surface preparation and painting practices currently used in various industries. Written from the viewpoint of paint

HOW CONVAIR PUT THE HEX ON HEAT

Hexcel glass-fabric honeycomb — long noted for its rigidity and excellent dielectric qualities — has a new use in Convair's B-58 Hustler. Heat resistant glass-fabric honeycomb — sandwiched between conventional metal skins — gave the Hustler's designers two big advantages in combatting heat in primary structures. **1**-Hexcel glass-fabric honeycomb core reduces internal temperature by as much as 40°. **2**-The glass-fabric sandwich presents a smooth surface for less air-friction . . . less heat. And, of course, the reduction in parts, (rivets, wing bracings, etc.), and improved structural efficiency through Hexcel Honeycomb sandwich construction saved thousands of pounds in the total weight of the plane. New shapes and new ideas in honeycomb sandwich construction — the result of engineering and research cooperation between Hexcel Products Inc., and Convair — contributed to the success of the Hustler. Hexcel's laboratories and sales-engineers are at the aircraft industry's immediate service.

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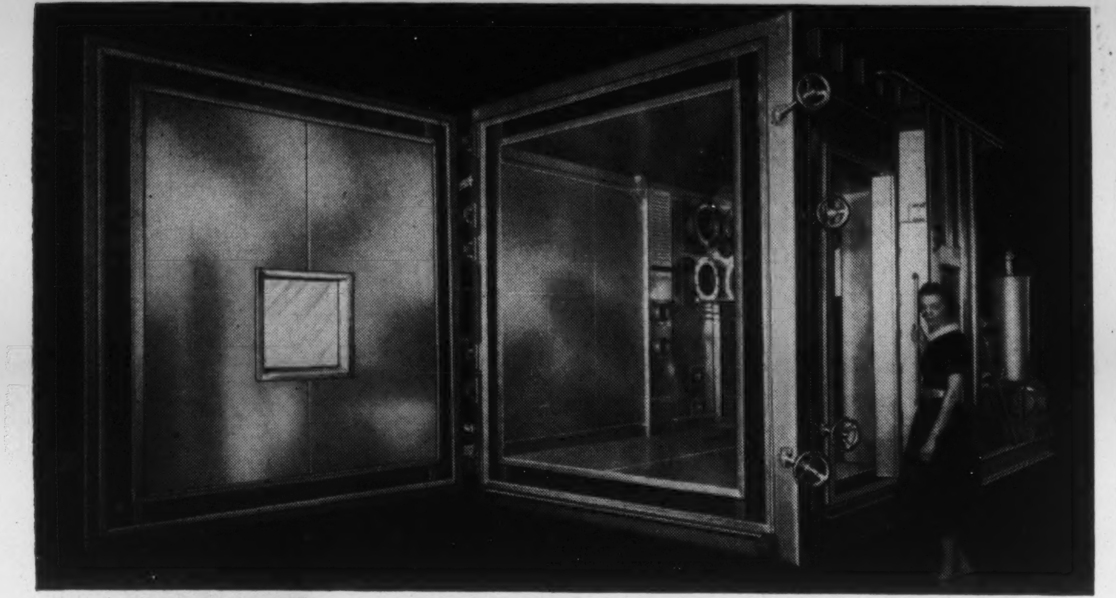

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users, the manual is a practical encyclopedia of proved painting methods rather than a technical treatise on paint formulation. Some of the subjects discussed in Volume I are: painting of steel vessels for salt and fresh water service; protection of pipelines and other underground structures; and mechanical and chemical surface preparation of steel for painting.

Volume II, Systems and Specifications. 1955. 300 pp. Contains a number of recommendations on painting steel structures and surfaces in various exposures. Complete guides and indexes make it easy for engineers, fabricators and maintenance men to correctly specify paint for new work or maintenance. The book also contains specifications for surface preparation, pretreatment, paint application, paints and paint systems.

Control of Steel Construction to Avoid Brittle Failure. *Edited by M. E. Shank. Welding Research Council, New York, 1957. Cloth, 6¼ by 9½ in., 194 pp. Price $4.50*

This book analyzes the notch sensitive properties of structural steel and summarizes data on steel design and construction. It is divided into three parts. Part 1 explains the mechanism of notch brittleness and discusses the mechanical and metallurgical factors that affect the local plastic behavior of structural steels. Part 2 deals with fabrication of structural steel components. Part 3 integrates the information of the first two parts to aid the designer in selecting and specifying the best constructural steels and fabricating techniques.

A Handbook of Hard Metals. *W. Dawihl. Philosophical Library, New York, 1956. 6 by 9¾ in., 170 pp. Price $10*

This book is an abridged translation of Dr. Dawihl's book, *Handbuch der Hartmetale.* The book explains the scientific principles involved in sintering hard metals and describes the production of hard metals. It also explains how hard metals are made into tools and how these tools are used in various applications.

Statistical Methods in Quality Control. *Dudley J. Cowden. Prentice-Hall, Inc., New York, 1957. Cloth, 6¼ by 9¼ in., 751 pp. Price $12*

The first 12 chapters of this book are concerned mainly with statistical methods in quality control. Other chapters deal with process and product control, elementary principles of

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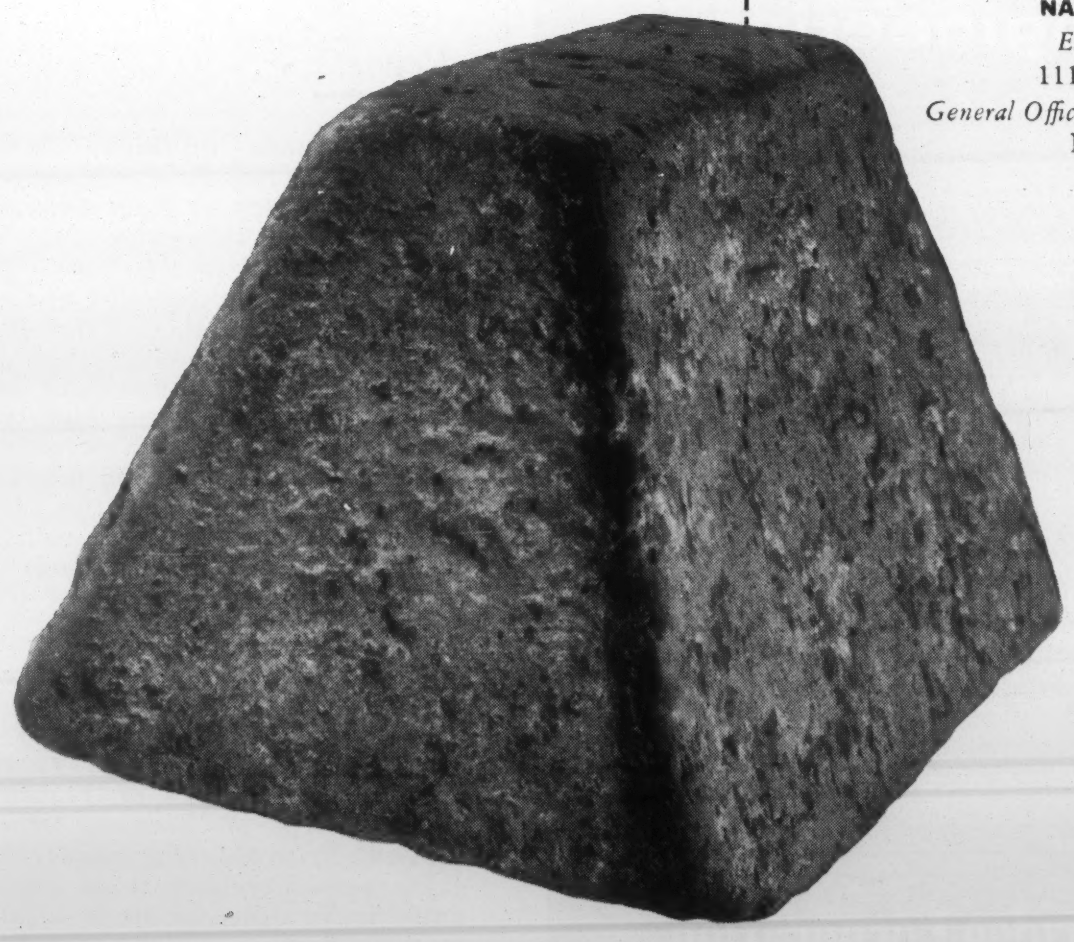

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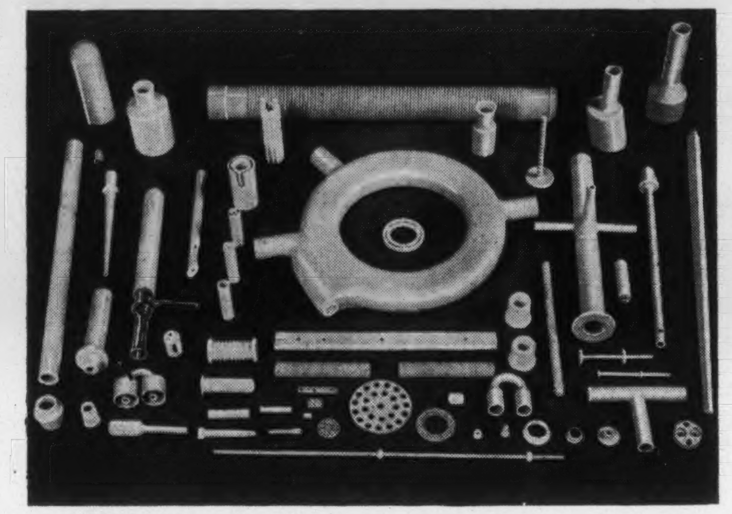

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probability, binomial and multinomial distributions, use of control charts, analysis of defectives, principles of lot acceptance sampling for attributes, and double sampling.

Although mathematical derivations of some formulas are given, nothing has been included that is mathematically difficult. The more tedious mathematical proofs are given in appendices at the ends of chapters.

An Introduction to Semiconductors. *W. Crawford Dunlap, Jr. John Wiley & Sons, Inc., New York, 1957. Cloth, 6 by 9 in., 438 pp. Price $11.75*

Included in this book are basic semiconductor concepts, properties of materials used in semiconductors, and information on applications of semiconductors. The book is designed as a source book of general information on all phases of semiconductor theory. Topics include: crystals and their structure, theory of the solid state, imperfections in crystals, the electron theory of metals and semiconductors, contact and surface properties of semiconductors, experimental measurements on semiconductors, and general methods of preparing semiconductor materials.

Reports

Metal-ceramic mixtures FUNDAMENTAL PROPERTIES OF METAL-CERAMIC MIXTURES AT HIGH TEMPERATURES. *Alfred University. Jan. '55. 103 pp, illus. Available from Office of Technical Services, Dept. of Commerce, Wash. 25, D. C. Price $2.75 (PB 121413)*

Summarizes development of new materials for high stress, high temperature applications. New materials were formulated from mixtures of metals and oxides and from lesser known metalloid and intermetallic compounds. Describes methods to measure of these mixtures at temperatures up to 3600 F.

Cast copper steels CAST COPPER ANTI-FRICTION STEEL. *A. A. Lunev. Translated from "Liteinoe Proizvodstvo" (Russian). Jan. '55. 15 pp. Available from Office of Technical Services, Dept. of Commerce, Wash. 25, D. C. Price 50¢. (PB 121364)*

Discusses development of copper anti-friction steels for use in casting machine parts. Admixture of lead reduced coefficient of friction, improved machinability and did not affect wearability of copper-aluminum steel. One type of cast copper steel

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Shop Talk

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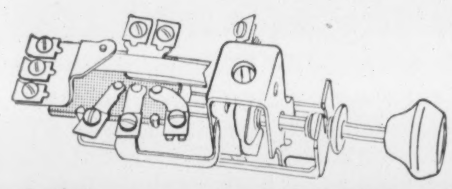
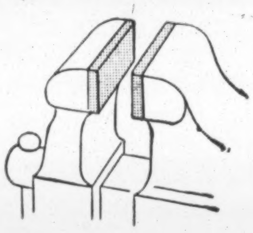
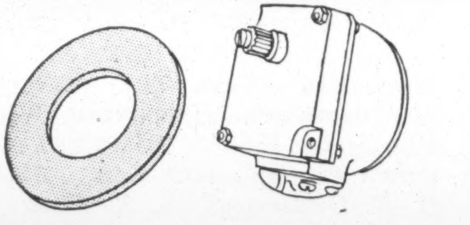
Tips for designers



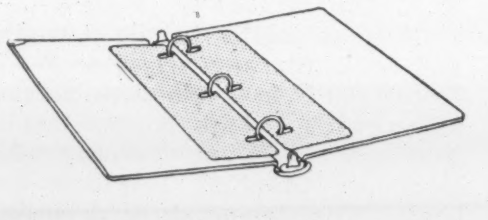
Back plate on an automobile headlight switch, punched and machined from Taylor Grade XP paper base laminate, has low moisture absorption and good dielectric strength.



Vise jaw caps, made of Taylor Grade C phenolic laminate, are easily cut and machined to shape. Marring of precision or delicate parts is eliminated.



Self-balancing servo motor has stator case insulator which is cold-punched from 1/64″ thick Taylor Paper Base Phenolic Laminate sheet.



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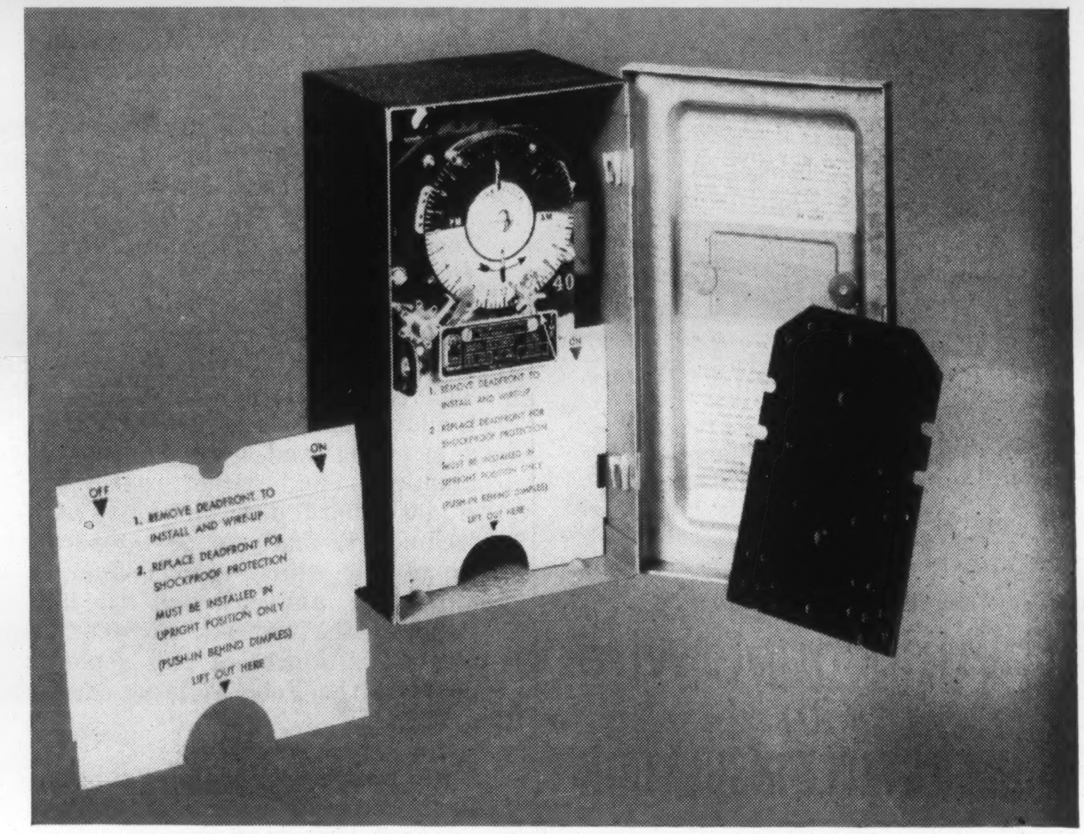
Taylor GEC (glass epoxy) Copper-Clad and Taylor XXXP-242 cold punching (paper-phenolic) Copper-Clad. Taylor uses high purity rolled copper on base materials with outstanding electrical properties.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Time switch, made by the Tork Clock Co., uses two Taylor products . . . the deadfront is made of vulcanized fibre for its insulating properties, shock protection and printability . . . the mounting panel of the clock is made of Taylor laminate XP-1-231, chosen for high strength and good punchability.

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For example, rigid requirements for insulation materials in the Tork Clock Company's Time Switch were met by two Taylor materials—a laminate and vulcanized fibre. The mounting panel is made of Taylor laminate XP-1-231, especially formulated for the high strength and good punchability requirements of this application. In addition, Taylor vulcanized fibre serves as the deadfront—a shockproof cover removed only for installation and service. Fibre was chosen for its insulating properties, shock protection, and printability.

Taylor materials are developed to meet the need for dependable, moisture-resistant insulation. They have high dielectric and mechanical strength, and maintain original characteristics over long periods of time, under severe operating conditions. When you choose—and use—Taylor products, you'll have performance with stability.

Taylor application engineers can help you obtain the Taylor material that matches the exact requirements of your product. Contact your nearest Taylor sales office.

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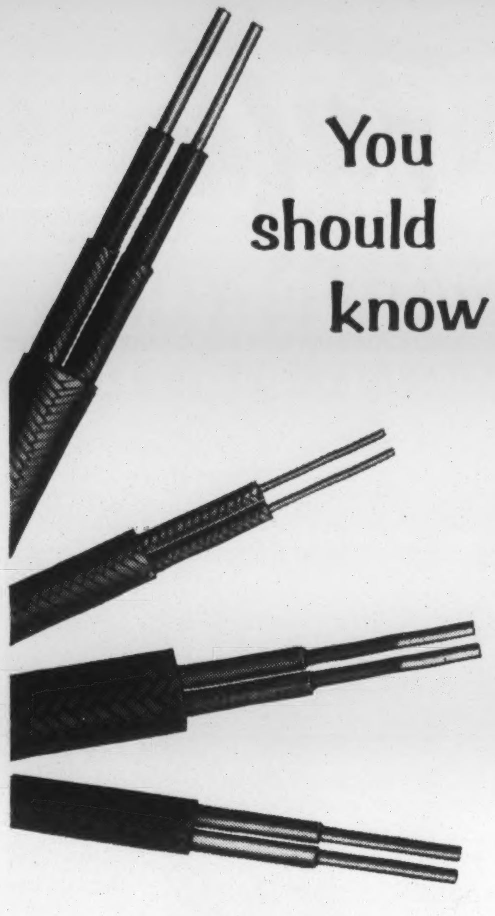

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Gordon's research and product development laboratory has worked out the application of bonded staple yarn to thermocouple wire and, now, offers to industry any Serv-Rite thermocouple wire or thermocouple extension wire with this new insulation. The commonly used wires are available for delivery from stock.

Gordon service engineers shall be glad to advise on the use of this new insulation in your particular applications. Write for full particulars.

Ask for Bulletin No. 1200-1

This bulletin gives the advantages of bonded staple yarn insulation and ordering information on several commonly used wires.

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BOOKS & REPORTS

is recommended as a replacement for brass and bronze in a number of applications. Another is recommended for large parts that are difficult to produce by powder metallurgy.

Metal surface treatments SURFACE TREATMENTS OF LOW ALLOY STEELS. *Sam Tour, Sam Tour & Co., Nov. '54. 261 pp, illus. Available from Office of Technical Services, Dept. of Commerce, Wash. 25, D. C. Price $5 (PB 121507)*

Guide for selecting surface treatments for low alloy steels for corrosion and oxidation resistance. Particular emphasis is placed on paint siliconizing and chromizing and on aluminum and nickel coatings. Includes general descriptions of coating techniques, analysis of temperature ranges to which each technique is applicable, and cost and life limitations of the various surface treatments. (A digest of this report appears in the Feb. '57 issue of M&M, p 212.)

Ball bearing steels STUDIES ON BALL BEARING STEELS (II): EFFECT OF SOME METALLURGICAL FACTORS ON THE LIFE OF BALL BEARING STEELS. *T. Mitsuhasha, M. Ueno and Y. Nakano, National Institute of Industrial Technology of Japan. July '56. 17 pp, illus. Available from Office of Technical Services, Dept. of Commerce, Wash. 25, D. C. Price 50¢ (PB 121427)*

Study of Japanese domestic ball bearings shows that chemical composition, nitrogen content and grain size bear no direct relationship to bearing life. However, residual cementite after heat treatment has a definite relationship. Life of the bearing is extended as hardness increases after heat treatment. Forging ratio of Japanese ball bearing steels is considerably below that of similar foreign steels.

Stress corrosion cracking STRESS CORROSION CRACKING IN TYPE *403* STAINLESS STEEL. *Ohio State Univ. Research Foundation. Aug. '56. 59 pp, illus. Available from Office of Technical Services, Dept. of Commerce, Wash. 25, D. C. Price $1.50 (PB 121414)*

Discusses effects of austenitizing temperature on the hardness, impact strength and microstructure of 403, 420 and 431 stainless steels. Data indicate that the mechanism of stress corrosion is the same for all three steels. Pitting characteristics are dependent on tempering temperature and therefore related to the microstructure of the alloy. Electrochemical corrosion is an important part of the cracking process. Electron microscopy and diffraction studies show presence of several carbides which appear to influence corrosion attack.

Stainless sandwiches PERFORMANCE OF STAINLESS STEEL SANDWICH CONSTRUCTION AT HIGH TEMPERATURES. *V. C. Setterholm and E. W. Kuenzi, Forest Products Laboratory, Sept. '56. 39 pp. Available from Office of Technical Services, Dept. of Commerce, Wash. 25, D. C. Price $1 (PB 121681)*

Results of tests conducted on an all metal sandwich material composed of stainless steel honeycomb with stainless steel facings show that lightweight stainless panels can sustain facing stresses as high as 57,500 psi at 1200 F. The material shows promise as a high temperature material for construction of airframes for high speed aircraft.

Metal fatigue EFFECT OF FREQUENCY AND TEMPERATURE ON FATIGUE OF METALS. *S. R. Valluri, California Institute of Technology. Feb. '57. 15 pp. Available from National Advisory Committee for Aeronautics, 1512 H St., N.W., Wash. 25, D. C. (TN 3972)*

Discusses properties of ductile metals on basis of a physical model called the "standard linear solid." The model shows that for particular temperatures there are corresponding frequencies of fatigue stressing above which the fatigue behavior of metals changes.

Iron-base alloys THE PRINCIPLES OF DISPERSION HARDENING WHICH PROMOTE HIGH-TEMPERATURE STRENGTH IN IRON-BASE ALLOYS. *E. E. Underwood, A. R. Elsea, and G. K. Manning, Battelle Memorial Institute. June 1956. 68 pp. Available from Office of Technical Services, Dept. of Commerce, Wash. 25, D. C. $1.75 (PB 121455)*

Creep strengths, tensile strengths, and hot hardnesses are measured at 80 to 1200 F in single-phase ternary alloys with a base composition of iron and chromium. Ternary additions are titanium, beryllium and boron. Time-temperature dependencies are shown for tensile strength and creep stress, and hot-hardness data. Comparison of these properties shows a relationship under various conditions of time and temperature. The hardness data can be used to predict correlations in other single-phase alloys.

Low permeability alloys MAGNETIC PROPERTIES OF LOW PERMEABILITY ALLOYS. *T. R. McGuire and F. S. Smart, Naval Ordnance Lab. Feb 1954. 16 pp. Available from Office of Technical Services, Dept. of Commerce, Wash. 25, D. C. 50¢ (PB 121169)*

Magnetic measurements of the susceptibility contribution to permeability made on Elgiloy, Inconel and Colmonoy alloys show that the

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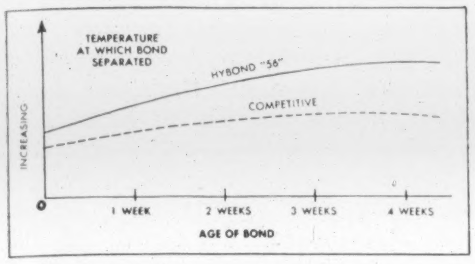
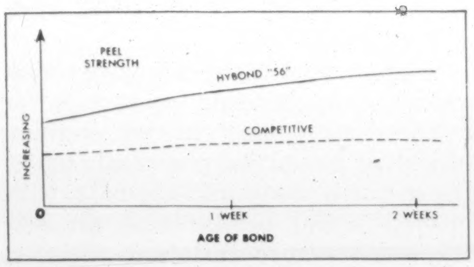


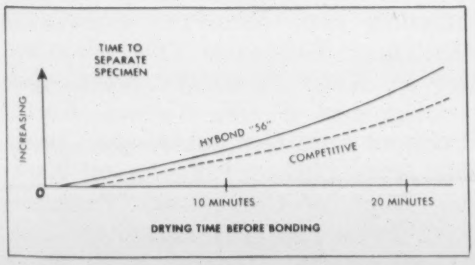
HEAT RESISTANCE

Plastic laminate bonded to wood. Specimen placed in oven under dead load in sheer. Temperature increased at constant rate until separation occurs. HYBOND "56" provides greater resistance to surface heats and the high storage temperature to which many finished products are subjected.



PEEL STRENGTH

Fabric-backed linoleum to steel. Peel strength determined on Scott tester. This chart demonstrates HYBOND "56" greater peel strength. HYBOND reaches a strength of 15 lbs. per inch at the end of two weeks.



RESISTANCE TO DEAD LOAD

Fabric-backed linoleum bonded to steel. Specimen 1" wide subjected to dead load immediately after bonding. Demonstrates HYBOND's ability to offer greater resistance to "fight" of surfacing materials when required to conform to contour.

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Thanks to latest developments in the field of chemical bonding, mass production techniques now prevail in more and more industrial laminating operations. Inseparable in this trend are *sprayable* contact adhesives which provide fast drying, instantaneous bonds. In consequence, these features eliminate the need for clamps, presses and complicated heat-curing schedules which retard production and increase cost burdens.

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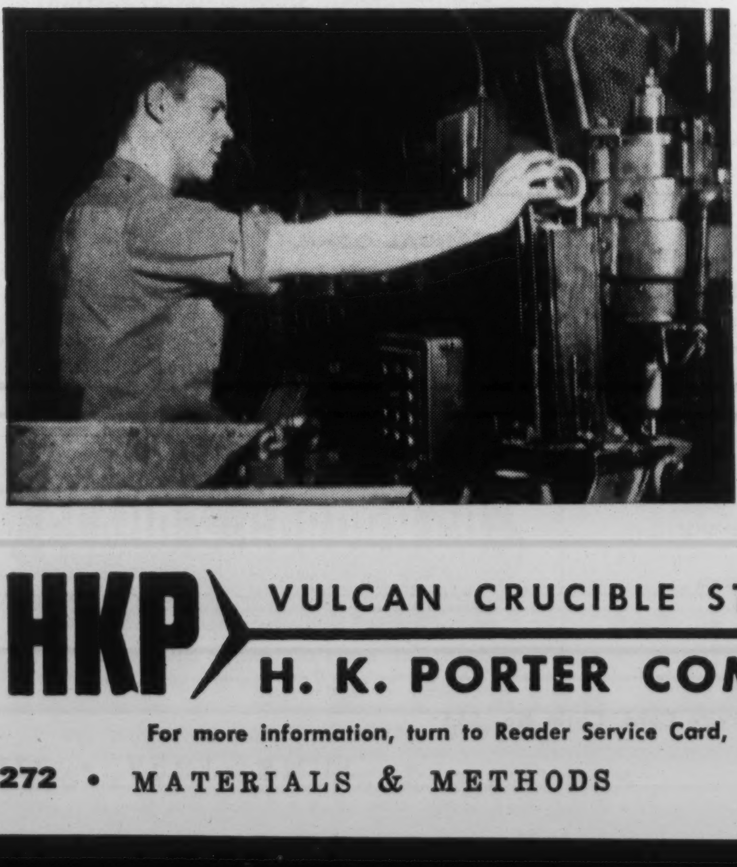

Photo at top shows General Foreman Robert Welch giving "specification plus" okay to DBM fittings as Vulcan representative examines tap used in manufacture.

Photo at left shows typical tapping machine operation at Detroit Brass & Malleable Company's nine-acre site.

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BOOKS & REPORTS

first two have paramagnetic contributions to the permeability. Colmonoy has more equal contributions from both paramagnetism and ferromagnetic impurities.

Degassing of metals THE EFFECT OF ULTRASONICS ON MOLTEN METALS. *J. B. Jones, J. G. Thomas and C. F. DePrisco, Aeroprojects Inc. Jan 1955. 127 pp. Available from Office of Technical Services, Dept. of Commerce, Wash. 25, D. C. $3.25 (PB 121403)*

Describes degassing of a melted aluminum alloy by ultrasonic activation. Accelerated degassing of 195 aluminum alloy was achieved at a nominal frequency of 15 kc. Grain refinement of the alloy also was accomplished with elastic vibratory energy at a frequency of 15 kc.

Ceramic adhesives RESEARCH ON ELEVATED TEMPERATURE RESISTANT CERAMIC STRUCTURAL ADHESIVES. *R. M. Spriggs, H. G. Lefort and D. G. Bennett, Univ. of Illinois. Sept '56. 99 pp. Available from Office of Technical Services, Dept. of Commerce, Wash. 25, D. C. Price $2.50 (PB 121659)*

Ceramic structural adhesives were evaluated as bonding materials for stainless steel used in jet engines. Adhesives tested were ceramic oxide, glassy bond coatings; cermets with sintered metal bonds; and air setting, temperature resistant silicates. Results were based primarily on shear strength tests at room temperature and at temperatures of 600 to 1000 F. An adhesive of the ceramic oxide, glassy bond type gave best results when used with 28-mesh stainless steel.

Silicone foam core PERFORMANCE OF SANDWICH WITH CORES OF FOAMED SILICONE AND MODIFIED POLYESTER RESINS AT ELEVATED TEMPERATURES AND AT HIGH HUMIDITY. *V. C. Setterholm and E. W. Kuenzi, Forest Products Lab. Oct '56. 30 pp. Available from Office of Technical Services, Dept. of Commerce, Wash. 25, D. C. Price 75¢ (PB 121707)*

Compression, tensile and shear strength properties of a modified polyester resin core and a core of silicone foam were determined at temperatures ranging from 75 to 700 F. Above 300 F the strength of the modified polyester core approached that of the silicone core. At 500 F the strengths were nearly equal but much lower than at room temperature.

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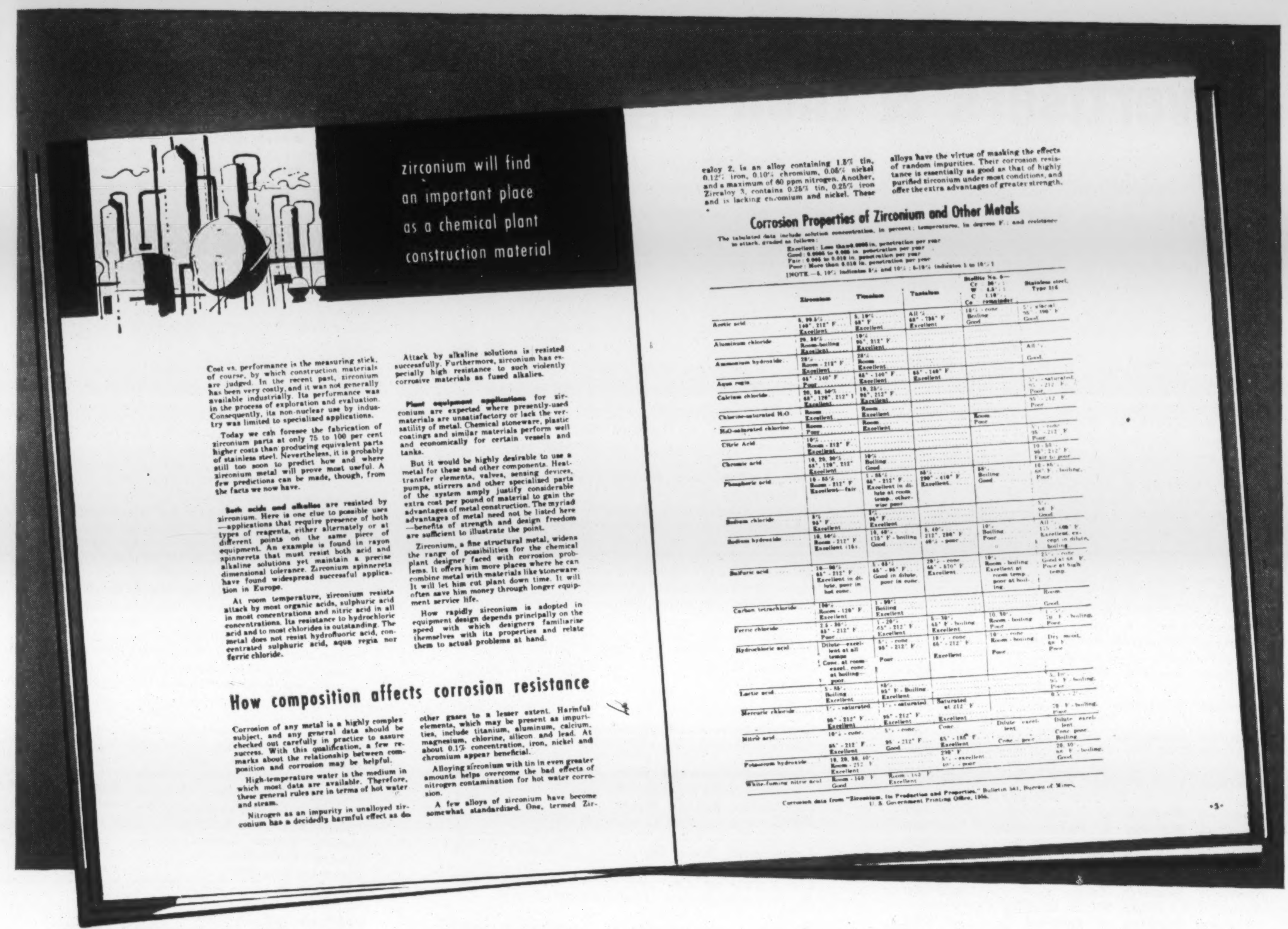
zirconium will find an important place as a chemical plant construction material

Cost vs. performance is the measuring stick, of course, by which construction materials are judged. In the recent past, zirconium has been very costly, and it was not generally available industrially. Its performance was in the process of exploration and evaluation. Consequently, its non-nuclear use by industry was limited to specialized applications.

Today we can foresee the fabrication of zirconium parts at only 75 to 100 per cent higher costs than producing equivalent parts of stainless steel. Nevertheless, it is probably still too soon to predict how and where zirconium metal will prove most useful. A few predictions can be made, though, from the facts we now have.

Both acids and alkalies are resisted by zirconium. Here is one clue to possible uses —applications that require presence of both types of reagents, either alternately or at different points on the same piece of equipment. An example is found in rayon spinnerets that must resist both acid and alkaline solutions yet maintain a precise dimensional tolerance. Zirconium spinnerets have found widespread successful application in Europe.

At room temperature, zirconium resists attack by most organic acids, sulphuric acid in most concentrations and nitric acid in all concentrations. Its resistance to hydrochloric acid and to most chlorides is outstanding. The metal does not resist hydrofluoric acid, concentrated sulphuric acid, aqua regia nor ferric chloride.

Attack by alkaline solutions is resisted successfully. Furthermore, zirconium has especially high resistance to such violently corrosive materials as fused alkalies.

Plant equipment applications for zirconium are expected where presently-used materials are unsatisfactory or lack the versatility of metal. Chemical stoneware, plastic coatings and similar materials perform well and economically for certain vessels and tanks.

But it would be highly desirable to use a metal for these and other components. Heat-transfer elements, valves, sensing devices, pumps, stirrers and other specialized parts of the system amply justify considerable extra cost per pound of material to gain the advantages of metal construction. The myriad advantages of metal need not be listed here —benefits of strength and design freedom are sufficient to illustrate the point.

Zirconium, a fine structural metal, widens the range of possibilities for the chemical plant designer faced with corrosion problems. It offers him more places where he can combine metal with materials like stoneware. It will let him cut plant down time. It will often save him money through longer equipment service life.

How rapidly zirconium is adopted in equipment design depends principally on the speed with which designers familiarize themselves with its properties and relate them to actual problems at hand.

How composition affects corrosion resistance

Corrosion of any metal is a highly complex subject, and any general data should be checked out carefully in practice to assure success. With this qualification, a few remarks about the relationship between composition and corrosion may be helpful.

High-temperature water is the medium in which most data are available. Therefore, these general rules are in terms of hot water and steam.

Nitrogen as an impurity in unalloyed zirconium has a decidedly harmful effect as do other gases to a lesser extent. Harmful elements, which may be present as impurities, include titanium, aluminum, calcium, magnesium, chlorine, silicon and lead. At about 0.1% concentration, iron, nickel and chromium appear beneficial.

Alloying zirconium with tin in even greater amounts helps overcome the bad effects of nitrogen contamination for hot water corrosion.

A few alloys of zirconium have become somewhat standardized. One, termed Zircaloy 2, is an alloy containing 1.5% tin, 0.12% iron, 0.10% chromium, 0.05% nickel and a maximum of 60 ppm nitrogen. Another, Zircaloy 3, contains 0.25% tin, 0.25% iron and is lacking chromium and nickel. These alloys have the virtue of masking the effects of random impurities. Their corrosion resistance is essentially as good as that of highly purified zirconium under most conditions, and offer the extra advantages of greater strength.

Corrosion Properties of Zirconium and Other Metals

Corrosion data from "Zirconium, Its Production and Properties," Bulletin 561, Bureau of Mines, U. S. Government Printing Office, 1956.

WHAT'S NEW ON ZIRCONIUM?

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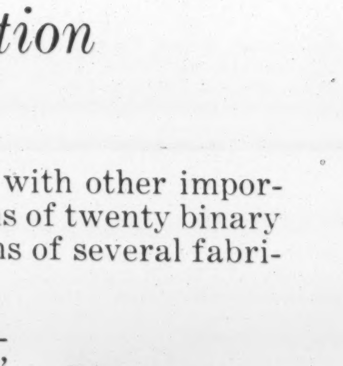

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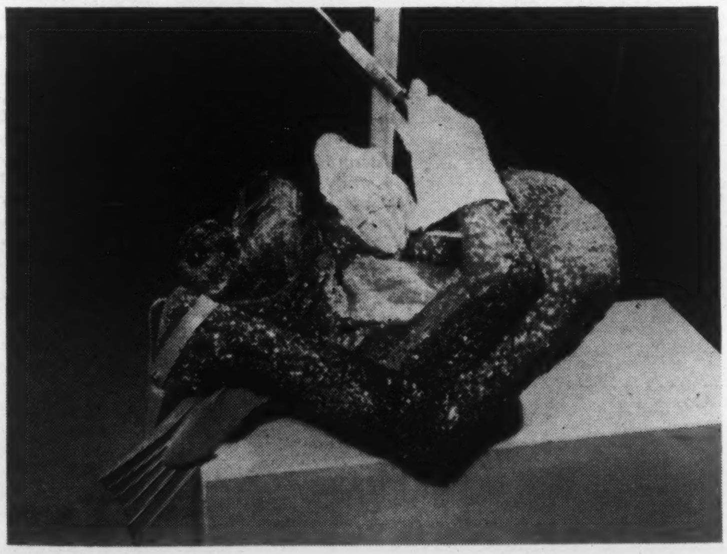
THE LAST WORD

by H. R. Clauser, *Editor*



What Is It?

With the shortage of engineers these days, don't be surprised if you see creatures like the one pictured above appearing here and there in engineering departments. According to A. O. Smith Corp. they are fast learners. With only three days of instruction this particular one was taught how to weld in all positions as you can see. But before I am swamped with inquiries from engineer recruiters asking me for more details, I will hasten to explain that this creature is really a professional contortionist employed at the recent Welding Show to demonstrate the ease of using a new iron powder type electrode.

Find Out What the Customer Wants

I have long felt that engineering materials producers and the product manufacturers who buy and use materials know too little about each other's needs and problems. A special report published by us several years ago listed many pressing materials needs of which the materials producers were not aware. And in a few cases it was evident that producers were actually concentrating on the wrong problems.

At their recent annual meeting, the American Zinc Institute held two panel sessions that were directed at doing something about gaining better understanding between producers and users. One panel, the first, was made up of representatives of the major zinc using industries. They did not hesitate to be critical, and they told the zinc producing industry in quite specific terms what new developments were needed to meet the demands of their fields. For example, Joseph Gurski of Ford and Ralph Thompson of GE both indicated an urgent need for new and more economical finishes for zinc die castings. A second panel, composed of zinc industry men, discussed the suggestions made by the user panel and then went on to say what they intended to do about them. This panel approach has a great deal of merit and other materials producer associations might well consider trying it.

A Spectacular

If you're tired of Vista Vision, Cinerama and all the other latest Hollywood spectaculars, we suggest you arrange to see the Alcoa movie called "Man on a Skyhook." It's the most original and imaginative industrial movie we have witnessed in a long time. You, the viewer, accompany a man on a skyhook (made of aluminum of course) through a world of practical everyday objects, as well as beautiful art forms, which are colored and textured in a myriad of hues. The movie portrays, as no words could describe, the possibilities of color and design with aluminum.

Conservation—Don't Drop It

Now that many of the common engineering materials are relatively plentiful again, conservation is a word that is in danger of once again disappearing from our engineering and industrial vocabulary. This is indeed unfortunate and short-sighted, and we hope that the article on page 107 will help focus attention on the fact that conservation should be practiced as a preventative philosophy and not only in times of emergency.

The author, F. P. Huddle, who is a conservation specialist with the Dept. of Defense, has said, "ten, twenty, thirty years from now, if we continue our present pattern of materials use, we will be desparately short of materials for either peace or war."

Another new development using

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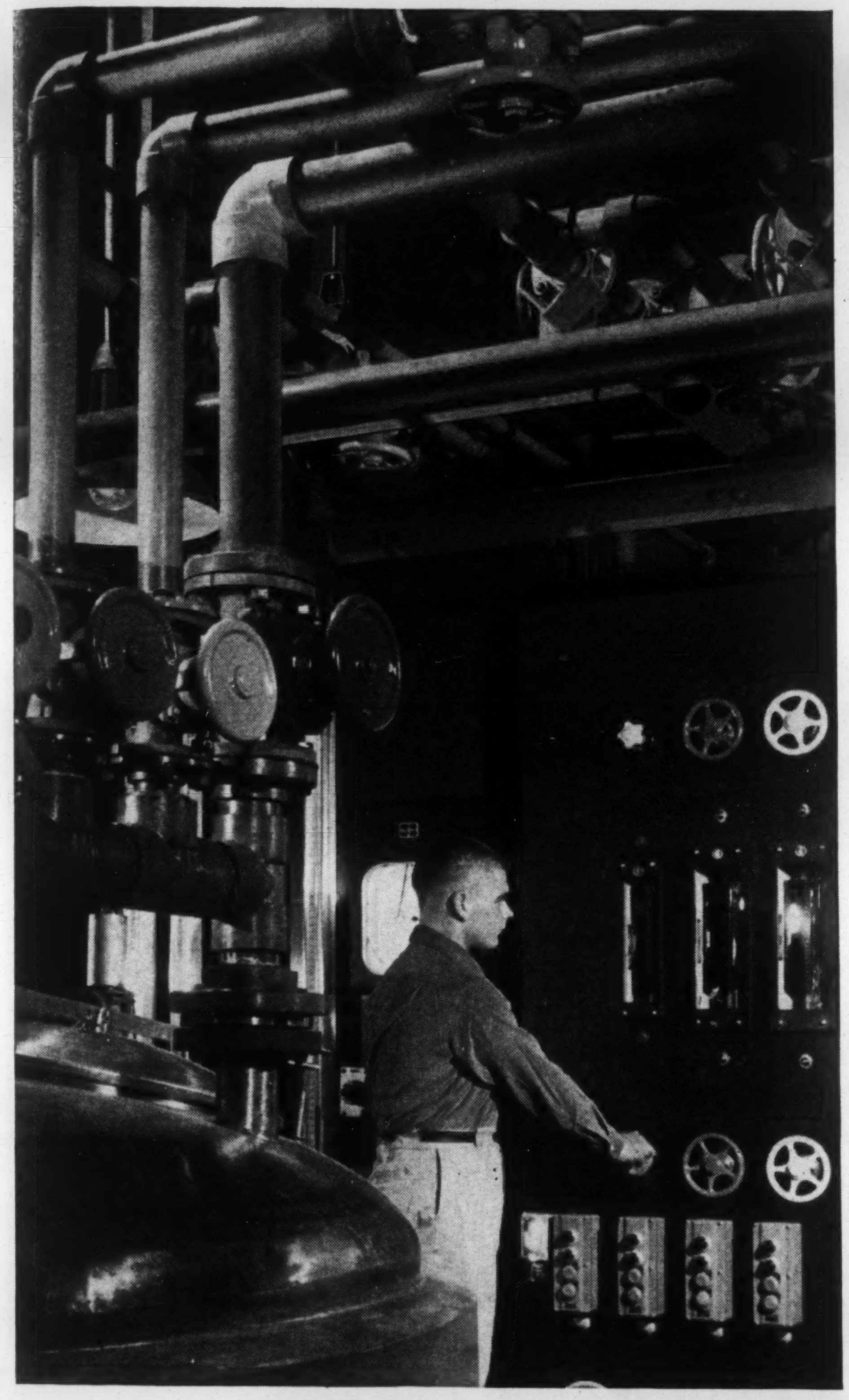

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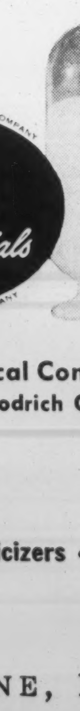

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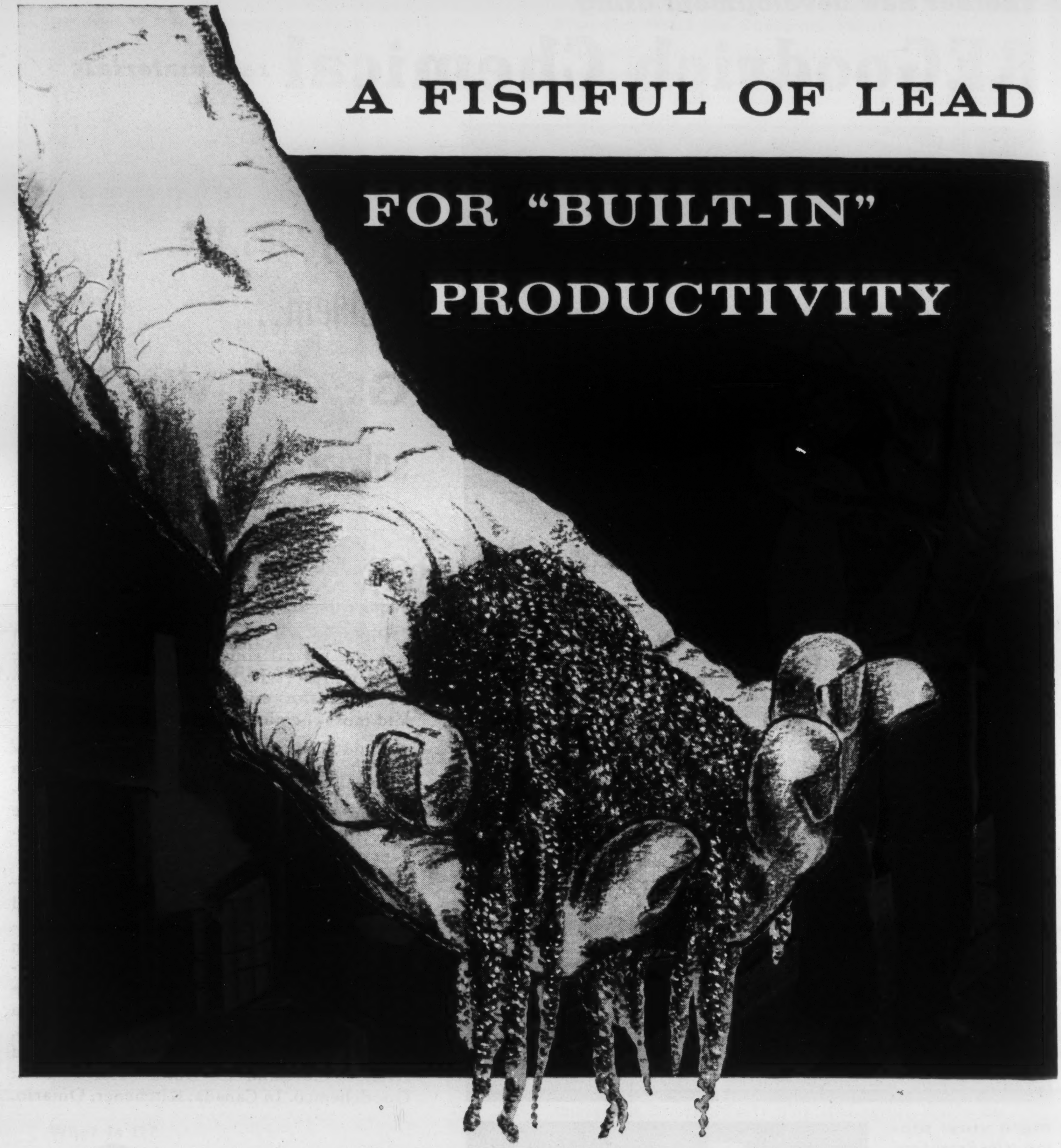
FOR "BUILT-IN" PRODUCTIVITY



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From luggage to wall coverings—from counter tops to garment linings DEXSTAR Specialty Papers provide the practical, economical solution to many tough laminating and stiffening problems.

Here, as in other applications, specific characteristics necessary to perform the job are "built-in"—with almost any desired combination of wet or dry strength, dimensional stability, porosity, tensile strength, thickness, softness, etc. Each formula is developed through carefully guarded processes known only to Dexter.

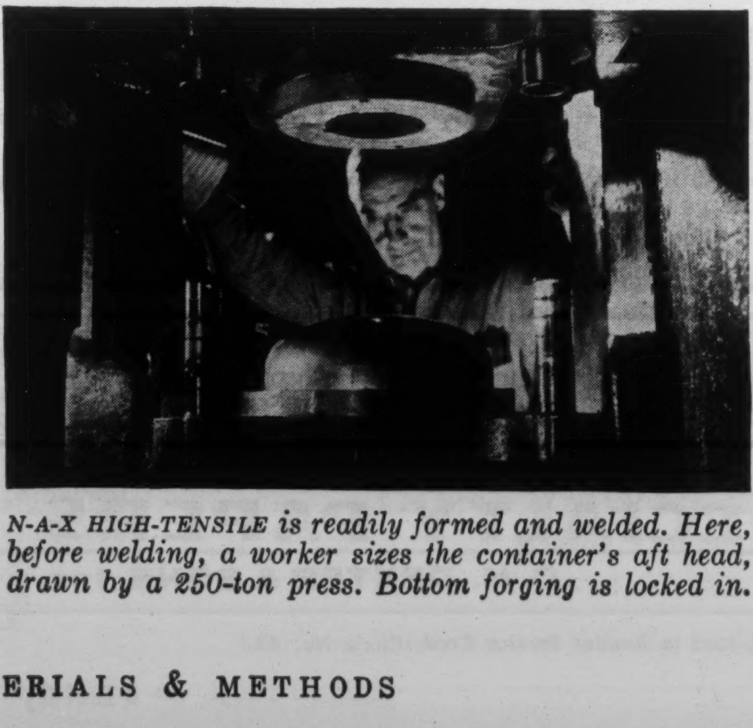
If you have laminating problems—look to DEXSTAR for a custom-made paper that will make your product more successful, more saleable.

*and saturating, filtering, insulating, coating, backing and other such problems, too.

Since 1767
DEXSTAR SPECIALTY PAPERS from Natural, Synthetic or Glass Fibers
C. H. DEXTER & SONS, Inc. Windsor Locks, Conn.

For more information, turn to Reader Service Card, Circle No. 485

A Boeing B-47 Stratojet medium bomber gets a take-off assist from 30 Phillips Petroleum Company M15 JATOs.

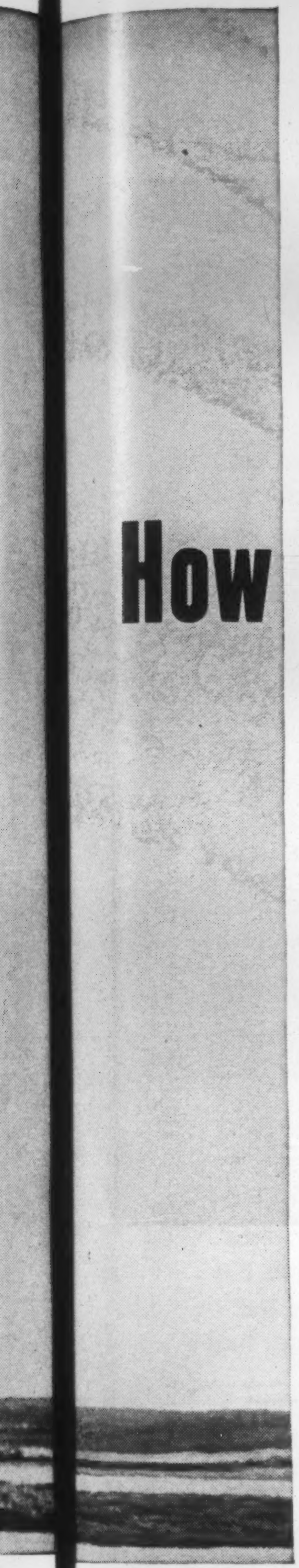


N-A-X HIGH-TENSILE is readily formed and welded. Here, before welding, a worker sizes the container's aft head, drawn by a 250-ton press. Bottom forging is locked in.

N-A-X HIGH-TENSILE STEEL FORMS AND WELDS READILY

Formability: Even at the higher strength levels (50% greater than mild carbon steel) this material can be cold formed and drawn into very difficult stampings and cold formed shapes.

Weldability: Its weldability by any process is excellent, maintaining toughness through a wide range of temperatures. Under-bead cracking tests are excellent. Using American Welding Society standard bead-weld testing, shows under-bead hardness rises only to 95 Rockwell from 80-85 Rockwell prior to welding.



Make *your* product better, too—
with this high-strength steel

How N-A-X® HIGH-TENSILE STEEL

supplied the money-saving answer to a critical take-off problem

JATO rockets boost heavily laden planes into the air faster, let them operate from shorter runways. A new JATO developed by Phillips Petroleum Company required a case that would endure a pressure of 1,000 pounds per square inch at the high blast temperatures. Yet it must be lightweight, easily fabricated, economical.

In 1954, 100 JATO cases of N-A-X HIGH-TENSILE steel were tested at Air Force Plant 66 near McGregor, Texas, where Phillips Petroleum is contractor-operator.

Result: The N-A-X HIGH-TENSILE case passed every test with flying colors. It *surpassed* the required standards for strength by as much as 20 percent.

The high-strength characteristics that make N-A-X HIGH-TENSILE a better steel for JATO fuel containers also make it better for many other types of pressure containers, where high strength and lighter weight are equally important. It is particularly suitable for Propane cylinders and pressure vessels for the chemical, automotive and oil industries, that must withstand severe interior pressures and handling abuses . . . and for such products as truck and trailer frames, wheels and bumpers, railroad and earth-moving equipment, shipping containers, pipe, and many others.

Other Important Advantages: N-A-X HIGH-TENSILE STEEL, compared with carbon steel, is 50% stronger • has high fatigue life with great toughness • is more stable against aging • is more resistant to atmospheric corrosion. It polishes to a high luster at minimum cost • has greater resistance to abrasion or wear • offers greater paint adhesion.

With N-A-X HIGH-TENSILE you can design longer life, strength with lightness, and economy into your products. Let us show you how.

N-A-X
HIGH-TENSILE STEEL

COMPANION HIGH-STRENGTH STEEL IN THE N-A-X FAMILY

N-A-X FINEGRAIN. A low-alloy high-strength steel ideally suited for applications where the enhanced resistance to atmospheric corrosion of N-A-X HIGH-TENSILE is not required.

N-A-X Alloy Division
GREAT LAKES STEEL CORPORATION
Detroit 29, Michigan — Division of
NATIONAL STEEL CORPORATION

N-A-X Alloy Div., Dept. E-1
Great Lakes Steel Corp., Detroit 29, Mich.
☐ Please send me 8-page illustrated technical catalog on N-A-X HIGH-TENSILE Steel.
☐ Please have your representative contact me.
Name__________ Title__________
Company__________
Street__________
City__________ Zone______ State______

For more information, turn to Reader Service Card, Circle No. 458

where the need is Critical

specify
TYGON
PLASTIC

THERE are some fields of industry, some professions, where more than ordinary care is required. Food is one, medicine another, chemical research a third. Here purity in its truest sense must be enveloped with meticulous care every step of the way.

Relatively minor elements of equipment often play a vital part. For example, if the tubing used to transport liquid food should be attacked by one of the food chemicals trouble could be serious; a life could be endangered if the wrong tubing were used to convey blood or blood plasma; a research project could fail if contaminants leached out to spoil a solution.

This is why those whose job it is to safeguard purity specify Tygon Tubing for critical tasks. This flexible, plastic tubing, crystal clear, flexible as a piece of string, tough as leather, resistant to acids and alkalies, offers a combination of properties found in no other material.

And like metal alloys, basic properties of this unique "flexible glass" plastic tubing can be varied to meet a wide range of special requirements. Thus, Tygon Tubing is made in many standard formulations and in innumerable special ones.

That is why those whose job it is to safeguard purity specify the specific formulation of Tygon Tubing designed to fit their exact needs . . . *for they know, as do we, that no single formulation can do all things well.*

Tygon plastic Tubing is made in many formulations, each designed for a specific usage . . . and in over 60 sizes, from ⅛" to 3" I.D. Write for Bulletin T-97.

PLASTICS & SYNTHETICS DIVISION
U. S. STONEWARE
AKRON 9, OHIO

5F

For more information, turn to Reader Service Card, Circle No. 451

DU PONT
REG. U. S. PAT. OFF.
Better Things for Better Living
. . . through Chemistry

PRODUCT ENGINEERING NEWS

LATEST PROPERTY AND APPLICATION DATA
ON THESE VERSATILE ENGINEERING MATERIALS:
ZYTEL®, TEFLON®, LUCITE®

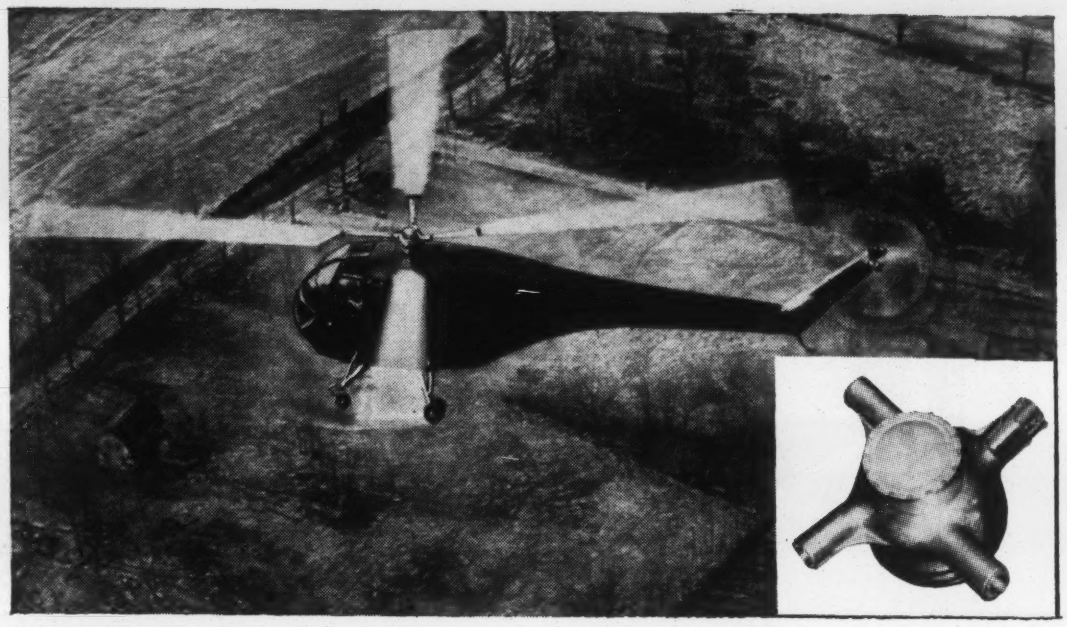
Tough, wear-resistant bearings of ZYTEL® nylon resin outperform conventional materials in helicopter rotor

"This application has solved all spar-tube galling problems," reports the Rotor Group Engineer at Doman Helicopters, Inc. "By eliminating galling problems in the Doman Rotor, there is no longer a need for field maintenance of the blade-retention system."

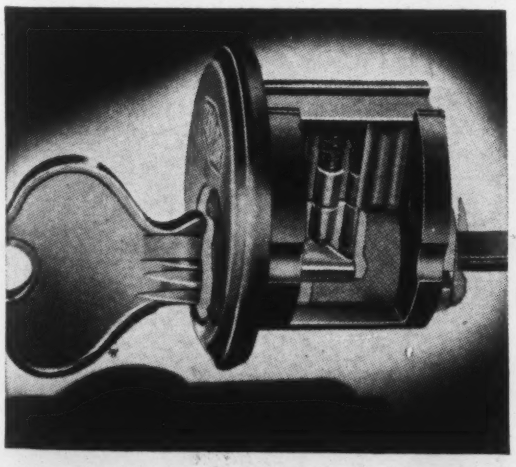
The application: a liner of ZYTEL nylon resin in the main rotor-blade bearing packs which support spar tubes in the arm of the rotor hub. The use of ZYTEL solved a problem of fretting corrosion which destroyed other sleeve bearings.

The excellent bearing characteristics and toughness of ZYTEL solved this engineering design problem. Other desirable mechanical properties include ease of fabrication by molding or machining from stock, strength in thin sections and resistance to impact.

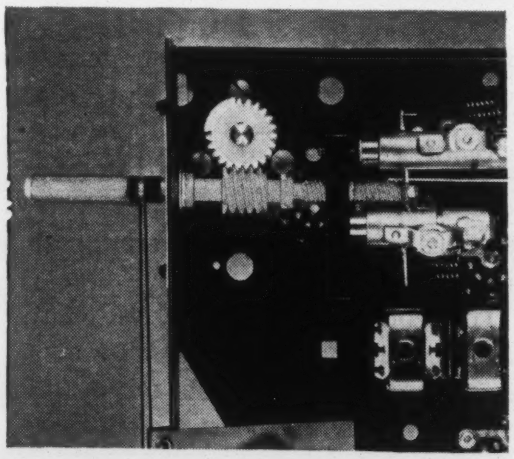
Many uses of ZYTEL are based also on its good electrical insulating properties. ZYTEL nylon resin is rated for intermittent operation up to 250°F.; for continuous operation at such elevated temperatures, heat-stabilized grades are available. ZYTEL resists the action of many common chemicals. Because of the low-friction characteristics and resiliency of ZYTEL nylon resin, gears, cams and bearings operate quietly, with little or no lubrication. Complicated shapes can be molded to precise dimensions around inserts.



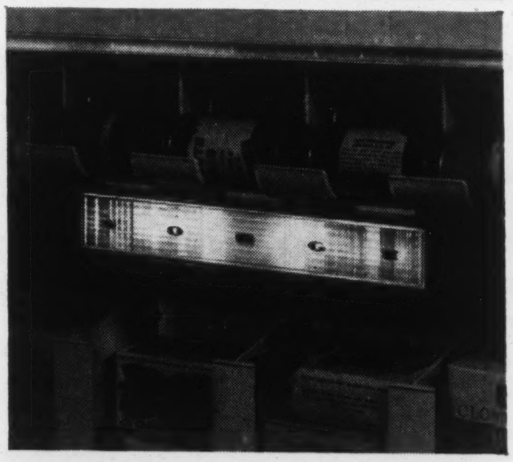
SLEEVE BEARING of ZYTEL supports spar tube in the arm of helicopter rotor hub. Bearing is 2" in diameter, 6" in length. Toughness of ZYTEL enables it to outperform other bearings. Spar-tube life is extended, maintenance reduced. (Made by Doman Helicopters, Inc., Danbury, Connecticut.)



CYLINDER PLUG for door lock is molded of Du Pont ZYTEL nylon resin. Cylinder lubrication is not necessary because of the low coefficient of friction of ZYTEL. The cylinder plug does not stick and turns smoothly in the lock. Unlike certain metals, the cylinder plug is corrosion-resistant and weatherproof and is not subject to electrolytic action. The hardness, durability and the abrasion resistance of ZYTEL nylon resin help insure against wear, and provide long service life for all parts molded of ZYTEL. (Door lock manufactured by The Taylor Lock Company, Philadelphia, Pennsylvania.)



INTRICATE TUNING SHAFT for radio selector mechanism is precision-molded of ZYTEL nylon resin. The shaft needs no lubrication yet operates easily. It is nonmagnetic and has high electrical resistance. Stiffness and torsional strength are more than adequate. Shaft has integrally molded gears, washers, holes, bevel and step. Considerable savings in fabrication costs over metal were realized. Components of ZYTEL nylon resin usually need no further finishing after molding. (Molded by Engineered Nylon Products, South Bend, Indiana, for Granco Products, Long Island City, New York.)



ILLUMINATOR LENS made of Du Pont LUCITE® acrylic resin distributes soft, even light throughout the interior of the new Norge Home Freezer. Located in the door, the lens also serves as an attractive name plate. Du Pont LUCITE is strong and tough . . . has remarkable optical properties, transmitting 92% of impinging light. LUCITE has high resistance to shattering . . . good dimensional stability. (Lens molded by Stimsonite, Division of Elastic Stop Nut Corporation of America, Chicago, Illinois; Freezer by Norge Sales Corporation, Chicago, Illinois.)

OVER

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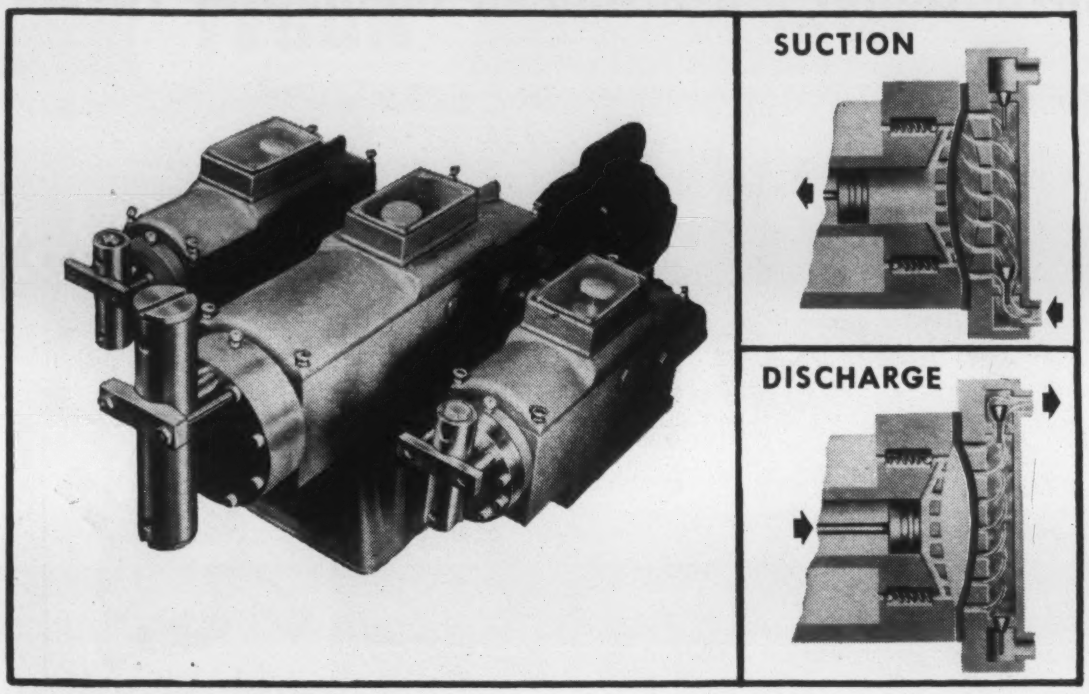
Better Things for Better Living
. . . through Chemistry

PRODUCT ENGINEERING NEWS

LATEST PROPERTY AND APPLICATION DATA
ON THESE VERSATILE ENGINEERING MATERIALS:
ZYTEL®, TEFLON®, LUCITE®

No. 3, 1957

Chemical inertness, high flex strength of TEFLON® resins are featured in pumps handling powerful corrosives



"PULSAFEEDER" DIAPHRAGM PUMP employs a tough, flexible diaphragm of a chemically inert TEFLON tetrafluoroethylene resin. Model shown is a triplex assembly used in handling hydrogen peroxide, sodium hydroxide and sodium silicate for bleaching fabrics. (Flexible diaphragm of TEFLON trademarked Fluorlastic by the Joclin Manufacturing Company, Wallingford, Connecticut; pump by Lapp Process Equipment Division of the Lapp Insulator Company, Inc., Leroy 6, New York.)

The Lapp "Pulsafeeder" can be used as a metering pump or as a proportioner, pumping two or more liquids in an established ratio. In the case of highly corrosive fluids, it depends on tough, flexible diaphragms of a TEFLON tetrafluoroethylene resin for resistance to chemical attack plus high strength.

On the piston side of the diaphragm, TEFLON tetrafluoroethylene resins are unaffected by any type of oil used as the hydraulic activating medium. On the pumpage side, TEFLON resins are completely inert to acids, aliphatics, aromatics, chlorinated hydrocarbons, alkalies and, in fact, almost any chemical or solvent in commercial use. The few exceptions to this include attack by the alkali metals under certain conditions. At high temperatures and pressures, halogens and certain halogenated chemicals and solvents may also affect TEFLON. TEFLON is rated for use to 500°F. and does not become brittle even at temperatures near absolute zero.

TEFLON 1, TEFLON 5 and TEFLON 6 resins may be used to make durable components such as seals, gaskets, packings and bearings. They are superb dielectrics.

The properties of TEFLON resins may have application in one of your own designs. Mail the coupon for a full report on uses and characteristics.

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Dept.
Room 106, Du Pont Building, Wilmington 98, Delaware

Please send me more information on the Du Pont engineering materials checked: ☐ *ZYTEL;* ☐ *TEFLON;* ☐ *LUCITE. I am interested in evaluating these materials for:*

____

*Name*____________________

*Company*__________ *Position*__________

*Street*____________________

*City*__________ *State*__________

*Type of Business*____________________

IN CANADA: Du Pont Company of Canada (1956) Limited, P. O. Box 660, Montreal, Quebec

SEND FOR INFORMATION

For additional property and application data on LUCITE® acrylic resin, TEFLON® tetrafluoroethylene resins and ZYTEL® nylon resin, mail coupon.

For more information, turn to Reader Service Card, Circle No. 361

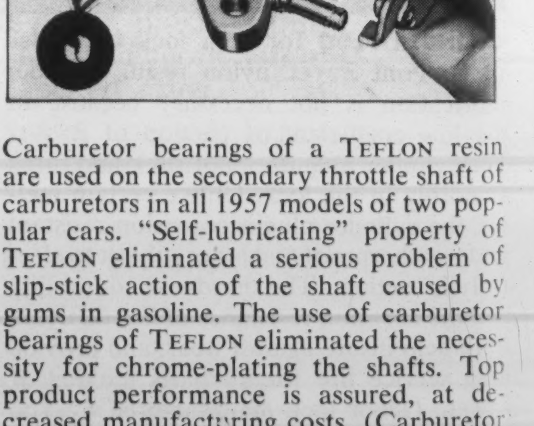
Thin-walled tubing of TEFLON® resins withstand soldering temperature, simplify assembly

TEFLON tetrafluoroethylene resins maintain high dielectric strength at elevated temperatures. They also have high surface resistivity, dropping only to 10^{13} ohms at 100% relative humidity. TEFLON maintains full electrical insulating characteristics, even when flexed or bent during assembly and installation. This combination makes it possible to miniaturize an electrical assembly without fear of dielectric failure.

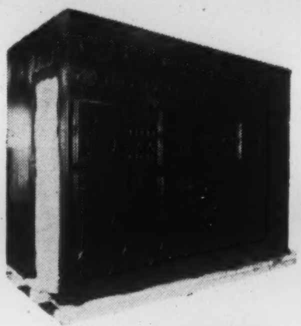
For example, thin-wall tubing of a TEFLON resin simplifies assembly of component parts in a series of miniature rotary tap switches. Since TEFLON resins will not burn, melt or decompose when connections next to them are soldered, assembly of switch parts is easier, faster, and the possibility of accidental grounding is minimized. The thermal stability of TEFLON resins, even in thin sections, is demonstrated in this tubing where the wall thickness is only .014". The nominal inside diameter is .075". TEFLON resins meet Class H, AIEE standards for maximum insulating temperatures.

TEFLON resins are non-flammable, have good mechanical strength and are completely unaffected by sunlight or outdoor weathering. They have zero water absorption by ASTM test D570-42, resist corrosion and growth of fungus, are chemically inert.

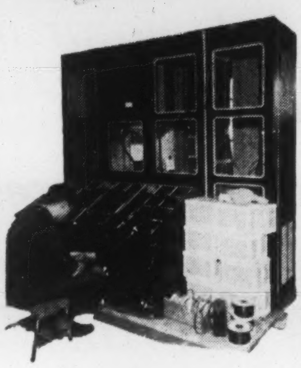
Carburetor bearing problem solved with TEFLON® resins



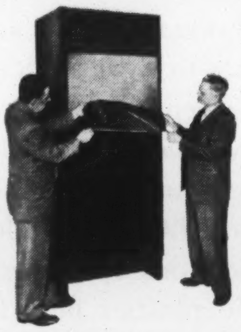
Carburetor bearings of a TEFLON resin are used on the secondary throttle shaft of carburetors in all 1957 models of two popular cars. "Self-lubricating" property of TEFLON eliminated a serious problem of slip-stick action of the shaft caused by gums in gasoline. The use of carburetor bearings of TEFLON eliminated the necessity for chrome-plating the shafts. Top product performance is assured, at decreased manufacturing costs. (Carburetor by Holley Carburetor Company, Van Dyke, Michigan; bearings by Modern Industrial Plastics, Inc., Dayton, Ohio.)



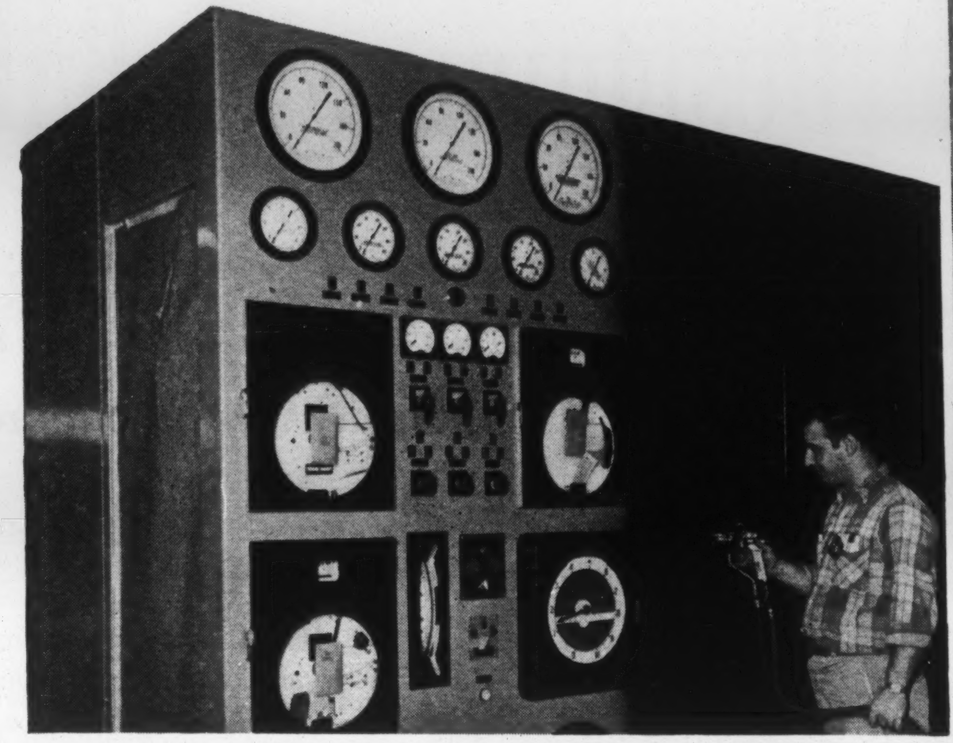
Panel board is completely coated . . . ready for safe overseas shipment.



Once coated, all wiring and connections can be made with no risk of damage to surface.



"Stripping-off" Spraylat after installation reveals a "factory-fresh" product.



Spraylat SC-1071 B is applied quickly . . . easily . . . to this central electric control room panel board.

Photos courtesy of Leeds and Northrup Co. and Allen B. DuMont Laboratories.

How to Protect your Product's Finish with SPRAYLAT Plastic Strippable Coating

Now . . . here is guaranteed protection for lacquered and enameled surfaces during manufacturing, storage and shipment. Simply spray on liquid Spraylat with any standard pressure type spray gun. This fire-safe compound dries to form a tight, tough rubbery film that protects against scratches, dirt, grease and oil. Spraylat is ideal for masking surfaces during painting, eliminating expensive taping.

Spraylat is just as easy to remove as it is to apply . . . "merely peel it off." You will find the finished product completely free from scratches, smudges and other defects. Spraylat eliminates expense of costly rejections, refinishing and touch-up and will assure your products of their "factory-fresh" appearance.

Fill out this coupon today . . . We'll be pleased to send you free bulletins about Spraylat Products. ⇨

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'Quality Protective Strippable Coatings Since 1937'

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For more information, turn to Reader Service Card, Circle No. 533

Designing with BAKELITE Plastics

- ***Colorful new coating needs no primer***
- ***Flexural strength of vinyl hinges***
- ***Durability plus chemical resistance***

The variety of BAKELITE plastics and resins gives you a valuable range of properties to work with in designing your product. These features can often lead the way to ideas for new products, or to new improvements. So it's shrewd planning to keep informed on the latest developments in plastics—to be sure of what you, or your competition, might put to good use.

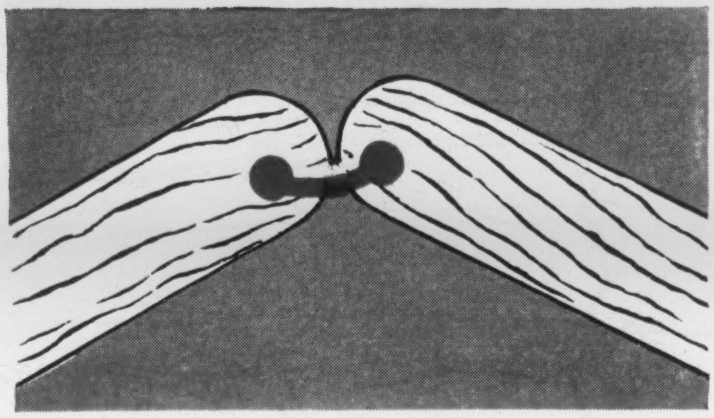
Here are some applications of materials made by Bakelite Company—a leader in the plastics field for 46 years. BAKELITE Brand Plastics and Resins include Phenolics, Styrenes, Vinyls, Epoxies, Polyesters, Polyethylenes, Silicones, and Impact Styrenes. In applying these modern materials to your own requirements, you can call on the extensive experience, laboratory facilities, and technical resources of Bakelite Company. Send full details to Dept. YD-108 for a thorough evaluation of your problem.

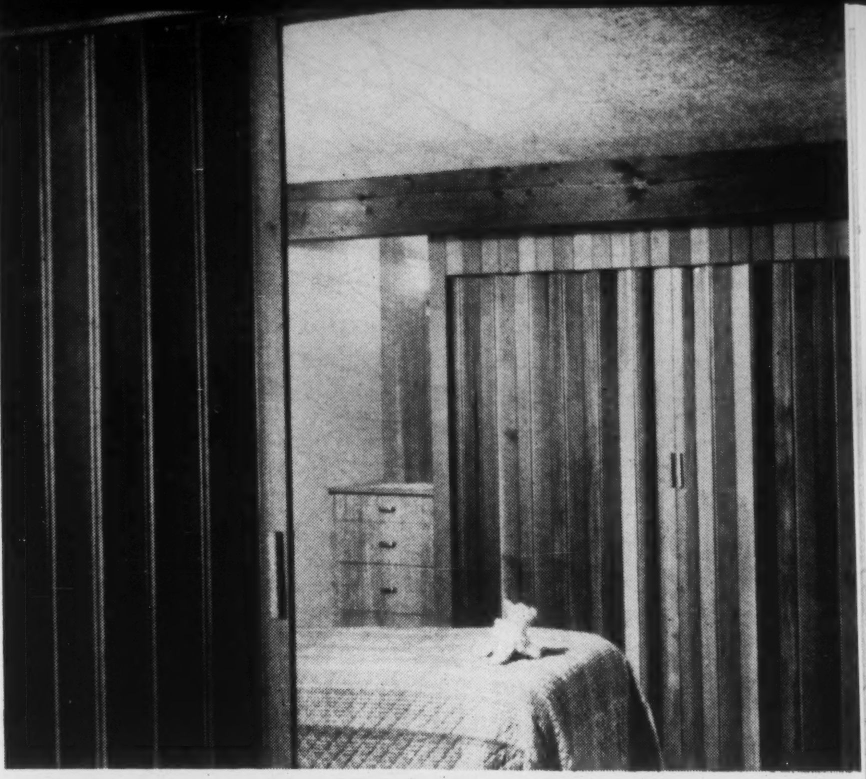
1 Molded phenolics get brilliant color at low lost

Phenolic plastics have long been noted for their economy and useful properties. But when bright color in broad range was needed, other materials had to be used . . . at higher cost. Now, a new coating based on BAKELITE Brand Epoxy Resins provides excellent hiding properties in a single coat. It adheres well with no primer required. Thus, you can still gain the production economy and quality performance of phenolic moldings, and have any hue of the rainbow as well.

This new enamel adheres not only to the glossiest phenolic surface, but equally well to steel, tin, brass, copper, aluminum, glass, wood, and many other plastics. It has excellent resistance to heat, corrosion, abrasion, and impact . . . can be high-gloss or flat in a wide variety of colors. Write Dept. XS-108 for copies of BAKELITE Coatings Technical Releases No. 15 and 16 for a description of epoxies for coatings.

See the difference . . . both black and brown phenolic molded articles can be given new color in a single coat without a primer. Adhesion test (inset) shows a coated copper strip cut with scissors and twisted vigorously. Finish does not crack or peel away from the base material.



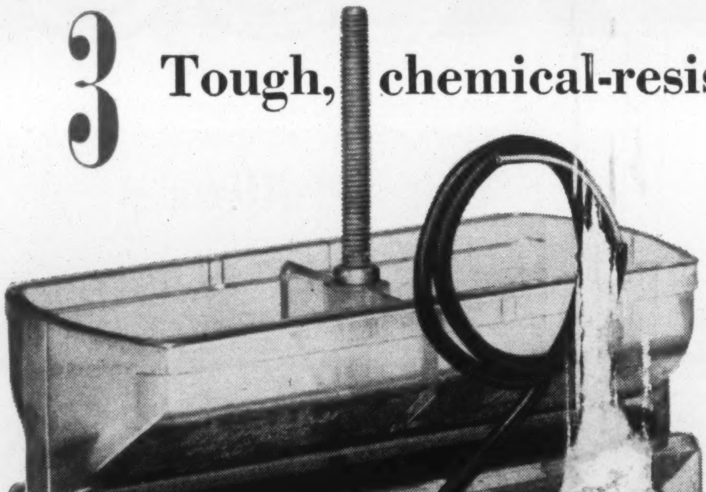


2 Strong, silent hinges for folding doors are extruded from elastomeric vinyl plastic

Full-length, one-piece hinges extruded from BAKELITE Brand Elastomeric Vinyl Plastic connect the panels of these folding doors. The manufacturer put them through 250,000 opening and closing cycles. They operated with friction-free smoothness; no squeaks, and no failures. The tough vinyl strips don't tear while being inserted, even though they are pulled through undercut grooves in the panel edges and their H-shaped cross section is formed for a tight fit. In addition, their flexing area is precisely the right thickness for proper functioning.

Another advantage of vinyls is resistance to household cleaning materials, waxes, paints, varnishes, and lacquers. Their color variety permits hinges to harmonize with the panel woods. For further information, write Dept. XT-108.

3 Tough, chemical-resistant C-11 plastic helps improve battery design



A frame molded of BAKELITE Brand C-11 Plastic forms the open top of the "EVEREADY" CG-500 railroad signal cell—an air-depolarized cell. It also holds the carbon-grid cathodes, exposing their inside surface to freely-circulating air, and supports the zinc-plate anodes. The whole assembly is suspended in a jar of 30 per cent potassium hydroxide liquid electrolyte. Operating temperatures can range from minus 20 to plus 80 deg. C.

The combination of properties found in C-11—mechanical strength, molding accuracy, dimensional stability, and chemical resistance—may be just what your designs call for. Versatile C-11 Plastic also matches industrial applications like this with benefits in the packaging and housewares fields, where it offers color, transparency, and resistance to attack by many food chemicals. For details, write Dept. XU-108 and ask for "Molding News," Vol. I, No. 4.

BAKELITE BRAND
PLASTICS

UNION CARBIDE

POLYESTERS • EPOXIES
PHENOLICS
IMPACT STYRENES
STYRENES • VINYLS
POLYETHYLENES • SILICONES

BAKELITE COMPANY, *Division of Union Carbide Corporation* UCC 30 East 42nd Street, New York 17, N. Y.

The terms BAKELITE, EVEREADY, UNION CARBIDE and the Trefoil Symbol are registered trade-marks of UCC.

For more information, turn to Reader Service Card, Circle No. 564

MARLEX* 50

POLYETHYLENE

Phillips new

MARLEX 50 for film—Outstanding protection because of low permeability and high abrasion resistance. Food can be cooked . . . medical supplies can be sterilized in sealed Marlex packages. Marlex is odorless. It safeguards flavors and fragrances.

Phillips
66

* MARLEX is a trademark for Phillips family of olefin polymers.

MARLEX* 50 NOW

"ON STREAM" IN COMMERCIAL QUANTITIES

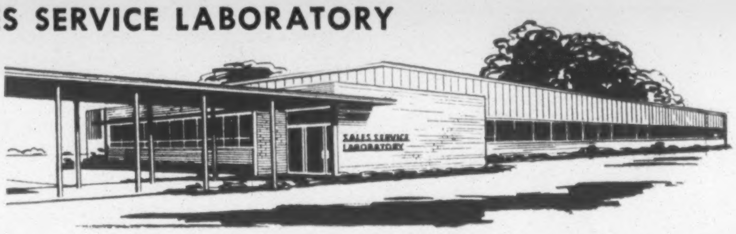
● THE LONG-AWAITED, revolutionary plastic, Marlex 50 is now available. It is a *new kind* of material, one of the most important developments in the plastic industry since polyethylene was introduced in 1939.

Your sales can now be increased with new and better products made from Marlex 50. Its greater resistance to heat and chemical attack, lower permeability, greater rigidity and other unusual properties offer a whole new field of profitable applications!

Manufacturing economies are yours through the greater strength and rigidity of Marlex 50 and its ability to set up at higher temperatures. Up to 40% more items per pound of resin . . . up to 25% faster cycle time in moldings. Yes, here's a *new kind* of plastic to help you produce better products more profitably. Today, call your local Marlex sales representative and find out more about how Marlex can make money for you.

NEW SALES SERVICE LABORATORY

Phillips experienced technical service staff will assist you in working out new products and processes utilizing Marlex. Make arrangements with your local Marlex sales representative.

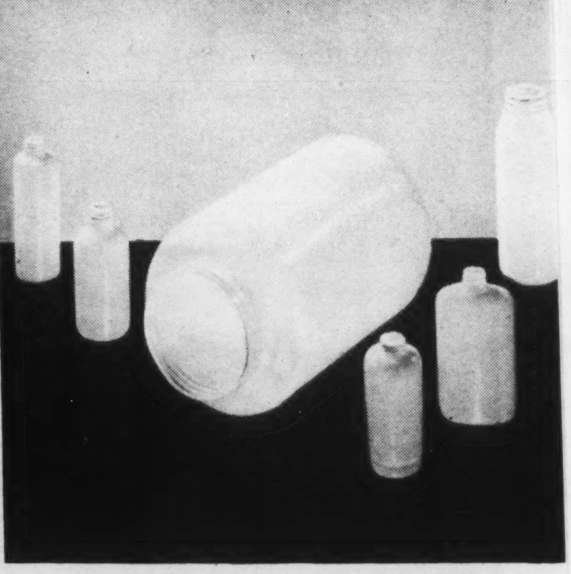


is Moving to All America

rigid polyethylene offers processors new market opportunities

MARLEX 50 for injection molding—Rich colors, glossy surfaces, fine details! Marlex 50 moldings withstand up to 250°F without losing shape . . . endure temperatures far below zero without losing toughness and pliability. Ideal for accurate vacuum moldings.

MARLEX 50 for fabrics—Easily processed into fabrics and rope with high tenacity and low elongation. Exceptional oil and chemical resistance. Withstands boiling soapy water, dry cleaning solvents, and prolonged exposure to sun and weather.



MARLEX 50 for blow molding—Rigid, tough, pure! Conforms intimately to mold surfaces. Remarkable resistance to chemicals and heat. Can be sterilized repeatedly. Excellent for bottling foods, drugs, chemicals, oils. Use Marlex 50 for caps and closures, too.

PLASTICS SALES DIVISION, PHILLIPS CHEMICAL COMPANY

A Subsidiary of Phillips Petroleum Company, Bartlesville, Oklahoma

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AKRON
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FRanklin 6-4126

CHICAGO
111 York Street,
Elmhurst, Ill.
TErrace 4-6600

WESTERN
330 Security Bldg.,
Pasadena, Calif.
RYan 1-6997

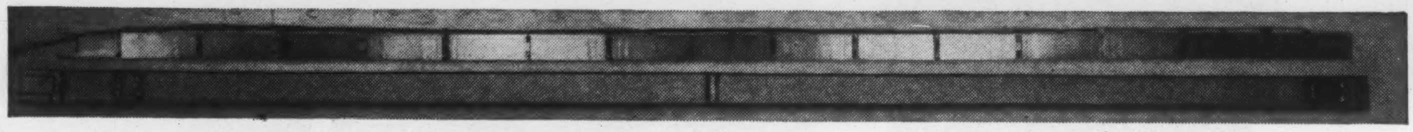
SOUTHERN & FOREIGN
Adams Building,
Bartlesville, Oklahoma
Bartlesville 6600

For more information, turn to Reader Service Card, Circle No. 500

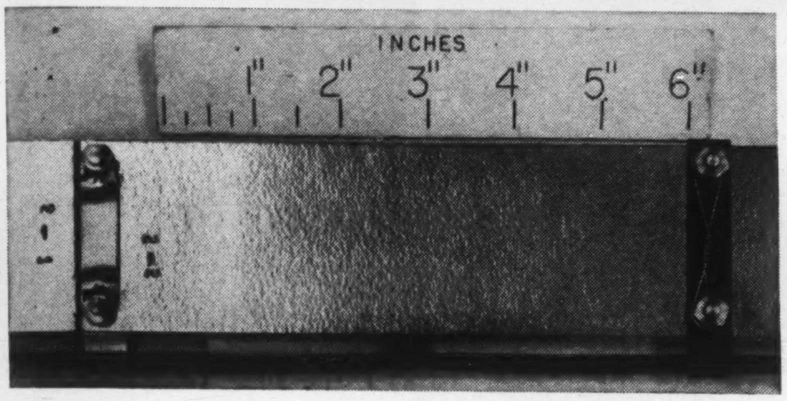
Fred Bingman, Metallographer, prepares metallographic specimens of irradiated materials by remote operation inside a shielded metallographic facility in the Bettis Atomic Power Division hot lab.

METALLURGICAL RESEARCH AND DEVELOPMENT

An Experimental Fuel Study of Uranium Alloys



A typical test array of instrumented uranium alloy fuel plates.



At Bettis Atomic Power Division laboratories, engineers and scientists are conducting basic research in the field of solid state physics and metallurgy to determine the behavior of nuclear materials under actual reactor conditions.

The experimental fuel plates shown on this page represent the initial step in a study of the temperature dependence of fuel materials to fission gas induced volume changes. These plates on an uranium-niobium alloy have been fabricated with thermocouples in the interior of the plates for constant temperature monitoring. The fuel enrichment is varied to provide the range of fuel temperature and fissioning rates of interest. The samples are being irradiated in a high temperature-high pressure recirculating water system at the NRX reactor site of Atomic Energy of Canada, Ltd., at Chalk River, Canada. The experiment will provide, in addition to data on fuel volume changes, information on neutron induced phase transformation kinetics and crystallographic changes.

This experimental fuel study is part of a joint program between the United States Atomic Energy Commission and Atomic Energy of Canada, Ltd. Bettis Plant conducts similar tests on nuclear fuel, control rod, and structural materials at other sites throughout the United States.

One of the foremost problems that face Bettis metallurgists is the dimensional stability of fuel materials under conditions of high temperature and high fuel burnup. Some of the experiments in connection with this problem include in-pile studies of phase transformation kinetics and fission gas diffusion rates. They also employ remotely operable X-ray and metallographic techniques in the post-irradiation analysis of samples of this type.

This is only one example of the challenging work conducted at Bettis Atomic Power Division. To investigate the excellent opportunities offered by the leader of the nuclear power industry, address your résumé to: Mr. M. J. Downey, Bettis Atomic Power Division, Westinghouse Electric Corporation, Dept. A-169, P.O. Box 1468, Pittsburgh 30, Pa.

Also, outstanding young metallurgists should write today for a descriptive brochure on our unique doctoral fellowship program in cooperation with Carnegie Institute of Technology.

BETTIS ATOMIC POWER DIVISION

Westinghouse

Next month—The Research and Development of Nuclear Fuels—A Study of Property Changes Under Radiation at Low Temperatures.

For more information, turn to Reader Service Card, Circle No. 548

PROPERTIES THAT MAKE FORTICEL A MORE DESIRABLE PLASTIC

Flow temperature: (°C.) (A.S.T.M.)	D569-48	167—178
Specific gravity	D176-42T	1.18—1.21
Tensile properties:		
Yield (p.s.i.)	D638-52T	3380—5020
Break (p.s.i.)	D638-52T	3470—5240
Elongation (%)	D638-52T	56—66
Flexural properties:		
Flexural strength (p.s.i. at break)	D790-49T	6400—8500
Flexural modulus (10^6 p.s.i.)	D790-49T	0.23—0.30
Rockwell hardness: (R scale)	D785-51	62—94
Izod impact: (ft. lb./in. notch)	D256-43T	2.7—11.0
Heat distortion: (°C.)	D648-45T	59—70
Water absorption:		
% sol. lost	D570-42	0.00—0.08
% moisture gain	D570-42	1.5—1.8
% water absorption	D570-42	1.6—1.8

AMERICAN OPTICAL *selects* **FORTICEL**

new Celanese propionate thermoplastic to personalize its Cool-Ray Polaroid Sun Glasses*

More and more manufacturers, designers and molders are turning to Forticel for its unique balance of properties—for its excellent moldability, superb surface finish, high impact strength—qualities that improve finished products, cut finishing operations.

Personal items, like American Optical's Cool-Ray* Polaroid Sun Glasses, derive immeasurable advantage from Forticel's freedom from objectionable odor. When Forticel-molded items are packaged or carried in a personal handbag, no objectionable odor is present to concentrate or build up. Products made of Forticel are virtually odorless—and remain so!

More and more famous name companies are discovering that Forticel's toughness and high speed moldability—its big plus combination of better dimensional stability, excellent form retention, and particularly its freedom from unpleasant odor—are properties that can be counted on to give products an important competitive advantage.

If you haven't evaluated Forticel, we urge you to do so. You will then understand why Forticel is being written into an increasing number of specifications.
Celanese Corporation of America, Plastics Division, Newark 2, N. J.
Canadian Affiliate: Canadian Chemical Co., Limited, Montreal, Toronto, Vancouver.

Export Sales: Amcel Co., Inc., and Pan Amcel Co., Inc., 180 Madison Avenue, New York 16, N. Y.

Celanese® Forticel®

*T.M. Reg. by Polaroid Corp.

Celanese
PLASTICS

Celanese Corporation of America, Plastics Division
Dept. 102-F, 744 Broad Street, Newark 2, N. J.

Please send me New Product Bulletin NP-16 on Forticel Plastics.

NAME______________________________

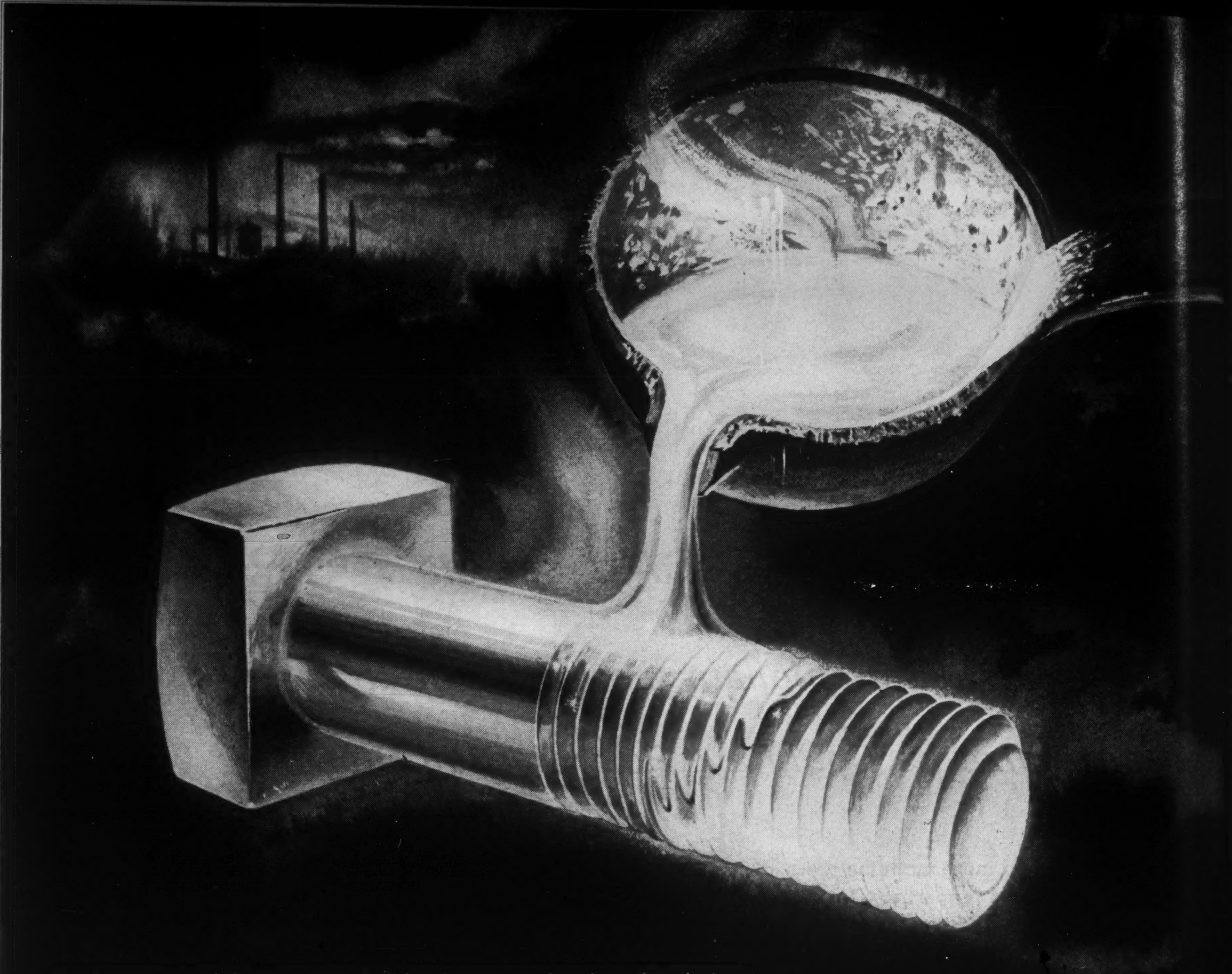
TITLE______________________________

COMPANY____________________________

ADDRESS____________________________

CITY____________ZONE_____STATE_________

For more information, turn to Reader Service Card, Circle No. 556



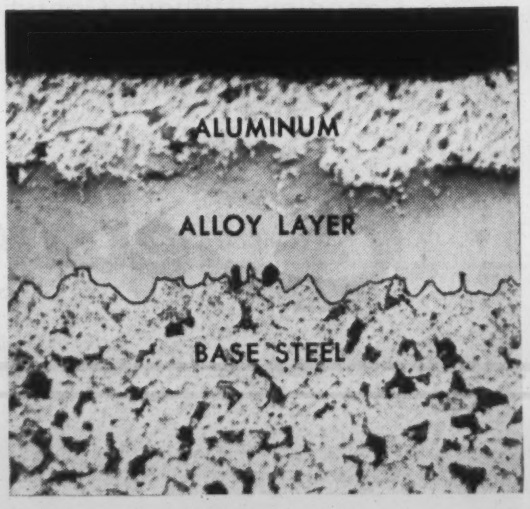
The illustration is symbolic — in practice, Bethlehem fasteners are dipped in molten aluminum, then centrifuged, producing a coating that is uniformly smooth over the entire surface.

Bethalume Coating for Fasteners is Superior in Corrosive Atmospheres

Looking for longer service life from steel fasteners exposed to corrosive conditions? Use fasteners which are protected by Bethlehem's Bethalume coating—the hot-dip aluminum coating which, in equal thicknesses, outlasts zinc in most corrosive atmospheres.

With Bethlehem's new coating facilities, fasteners of virtually all types and sizes can be coated with a smooth layer of corrosion-resistant aluminum. Excess coating is removed quickly while in the molten state, leaving the coated threads clean and sharp.

If you would like to know more about the Bethalume coating for fasteners, and the long service life it makes possible in atmospheric and heat corrosion, just get in touch with the nearest Bethlehem office.



Section through Bethalume coating, showing aluminum overlay and iron-aluminum alloy layer.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

For more information, turn to Reader Service Card, Circle No. 435

Redesigning in polyethylene can cut costs, add sales appeal

Here's a new way to make a box.

It illustrates how Tenite Polyethylene plastic is being used to simplify product manufacture and improve product design. No assembly operations are needed to make these boxes. They come out of the molding machine completely finished. Top, bottom, hinges, and clasp are all molded in one piece of colorful Tenite Polyethylene.

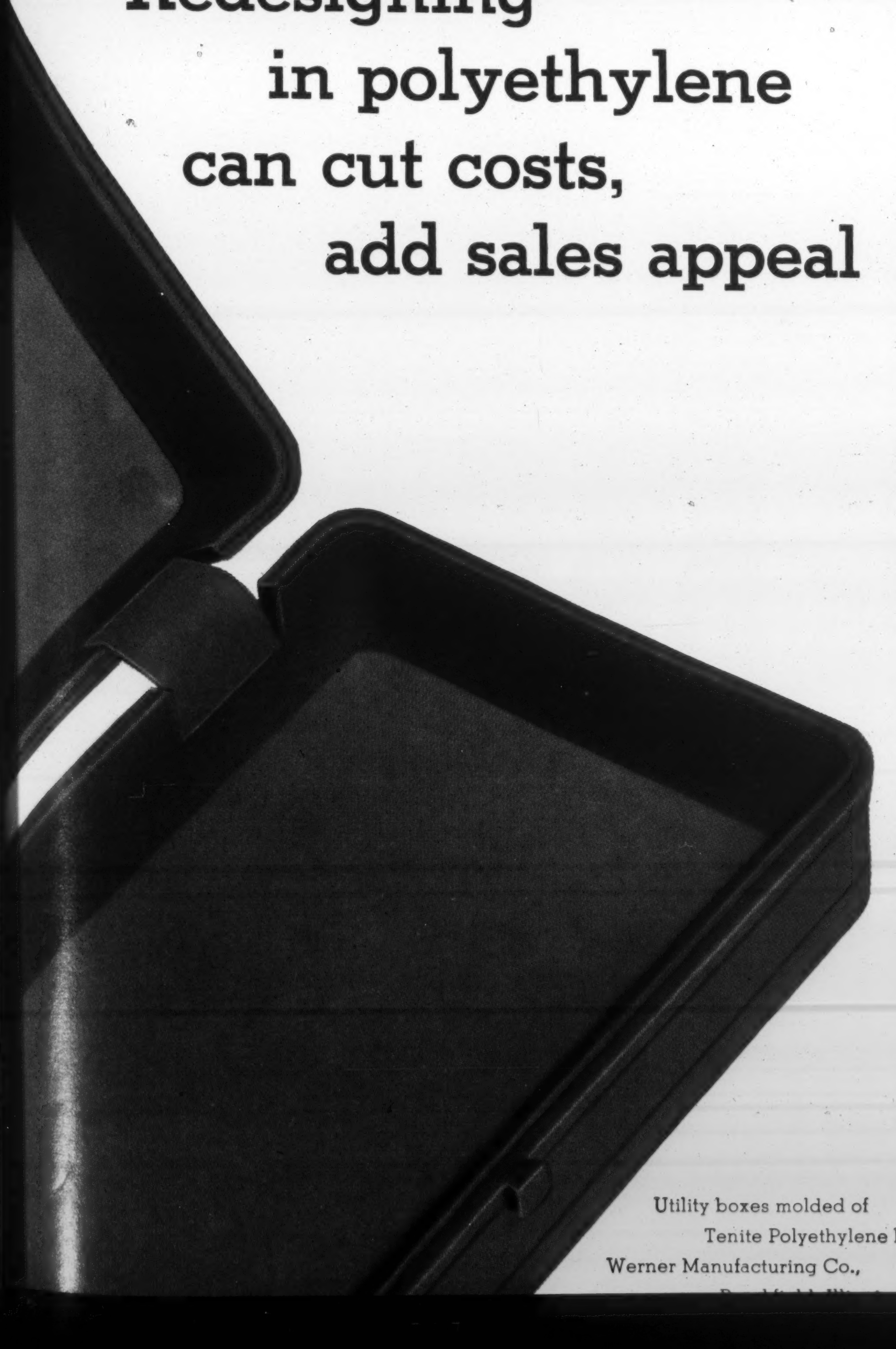
The boxes can be made in any color and can be formed with surfaces to simulate wood grain or leather . . . or product names can be molded right in, if desired. They're practically unbreakable, too, since the resilient plastic quickly recovers from crushing or other abuse.

Does this new use for versatile Tenite Polyethylene point the way to possible production economies and product improvements for you? Write for information on this useful plastic, and feel free to discuss your ideas with us. EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

TENITE
POLYETHYLENE
an Eastman plastic

1932—EASTMAN'S 25TH YEAR IN PLASTICS—1957

For more information, Circle No. 475



Utility boxes molded of
Tenite Polyethylene by
Werner Manufacturing Co.,

PROBLEMS:

STRESS-CORROSION CRACKING OF STAINLESS STEEL?

PRODUCT CONTAMINATION BY IRON PICK-UP?

PROVIDING A UNIFORM, HARD, RESISTANT COATING TO COMPLEX SHAPES?

DESIGNING LARGE AND SMALL CHEMICAL PROCESS EQUIPMENT ON A COST BASIS WHICH MAKES SOLID ALLOY OR ALLOY CLADDING ECONOMICALLY UNSOUND?

SOLUTION: KANIGEN®

That's a bold answer, but Kanigen has successfully solved every one of the problems listed above! Kanigen is a new kind of nickel alloy developed commercially by General American Transportation Corporation. More than that, it is an entirely new process. Not a substitute for electroplating, Kanigen chemically coats large and complex shapes with a uniform corrosion-resistant surface of exceptional hardness—can solve *your* problem at a saving of both time and money.

The process is available for small and large parts, pressure vessels, fractionating towers, absorbers, cylinders and shapes up to 50 feet in length. For complete information, write to the Kanigen Division.

KANIGEN
GENERAL AMERICAN
TRADE MARK

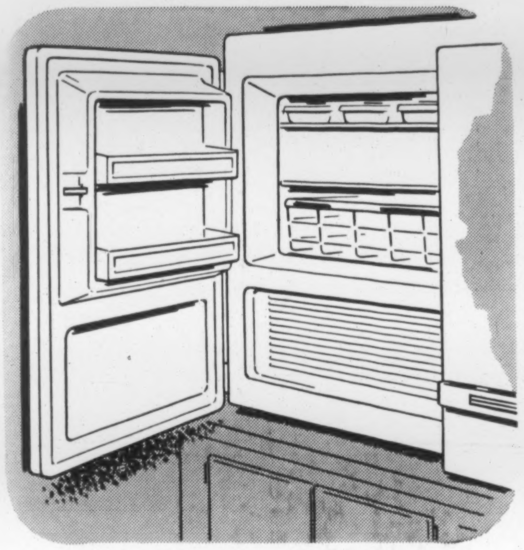
It Pays to Plan With General American

GENERAL AMERICAN TRANSPORTATION CORPORATION

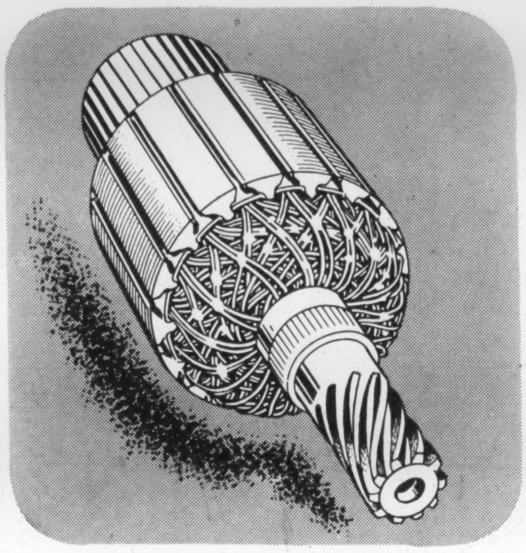
135 South La Salle Street • Chicago 90, Illinois.

For more information, turn to Reader Service Card, Circle No. 530

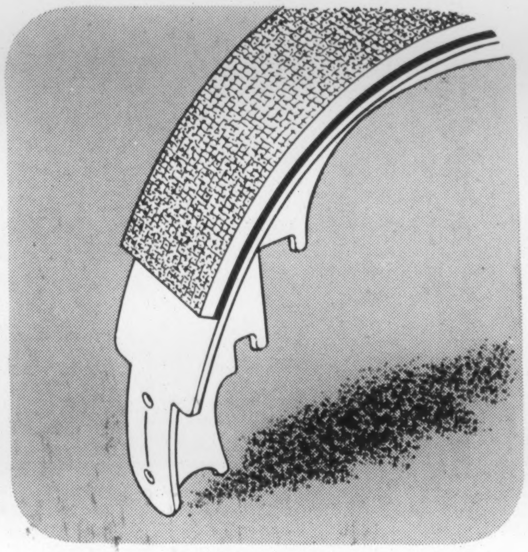
You can save time and money with R/M Ray-BOND® Adhesives



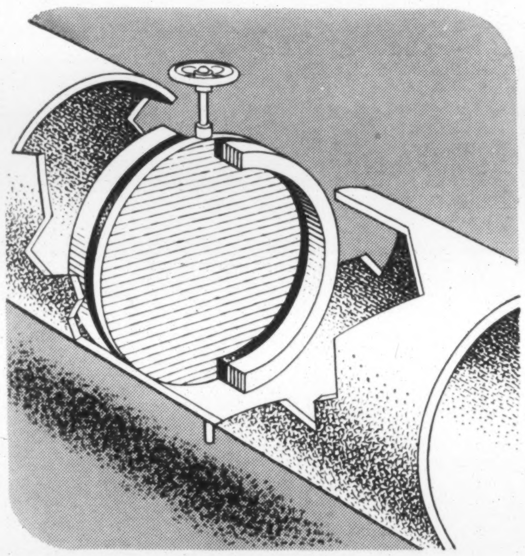
Bonding laminated panels of all-plastic refrigerators



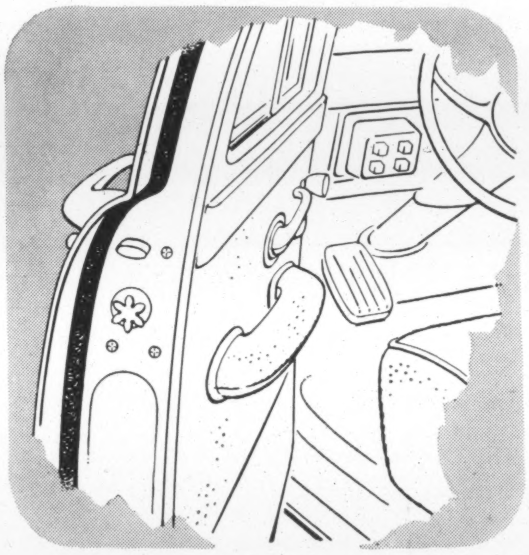
Bonding, sealing, protecting armature coils



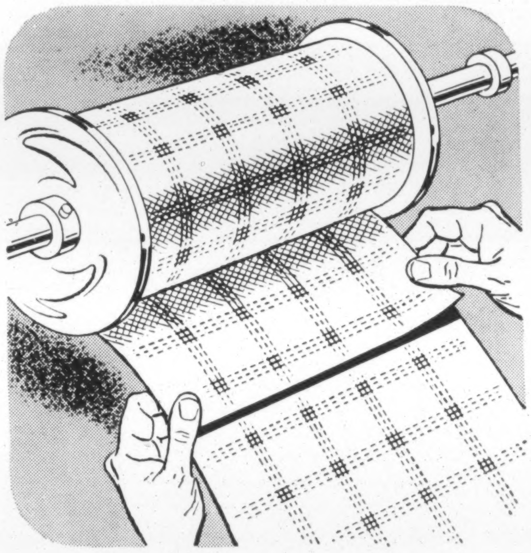
Bonding friction materials to metal



Bonding rubber seals to valve gates



Bonding sealing strip to car door



Bonding textile to textile

FOR THESE AND COUNTLESS OTHER APPLICATIONS NEW R/M RAY-BOND ADHESIVES CAN BE TAILORED TO YOUR NEEDS

Modern bonding techniques can simplify and improve product designs and eliminate troublesome production fastening operations. Shown above are a few applications which may suggest where R/M Ray-BOND adhesives, protective coatings, and sealers can have important advantages for you—*whether or not* bonding, laminating, sealing or coating are now factors in your operations.

From more than 20 years of experience in the production of bonded assemblies, R/M has acquired a wealth of experience in developing adhesive products to save time and money in varied applications. Call on our engineers to work with yours in finding new ways to cut costs and simplify production. Adhesives Department, Raybestos-Manhattan, Inc., Bridgeport, Conn.

R/M Bulletin No. 650A contains engineering information you will want on Ray-BOND adhesives, protective coatings and sealers. Write for your free copy.

RAYBESTOS-MANHATTAN, INC.

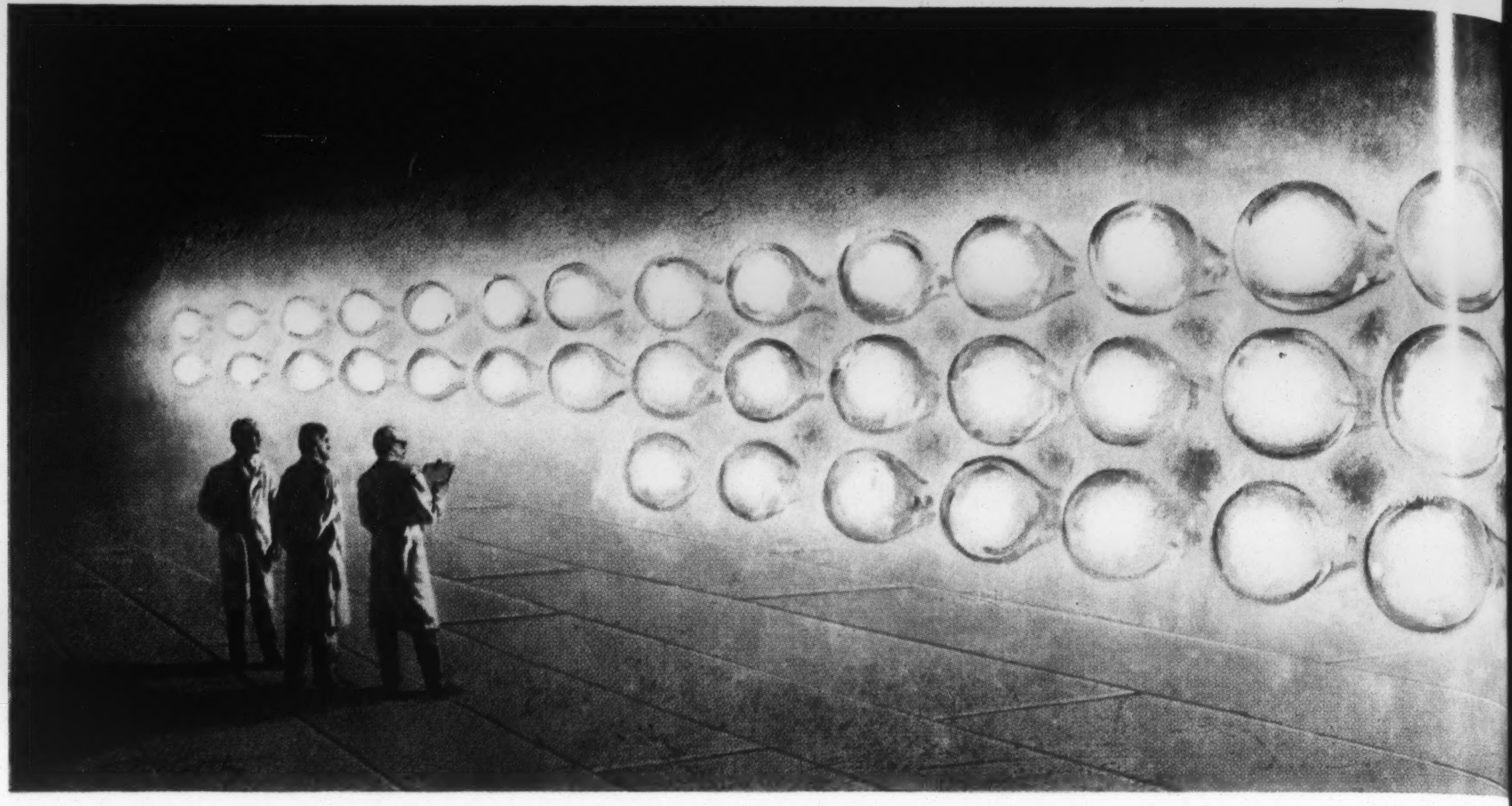
ADHESIVES DEPARTMENT: Bridgeport, Conn.

Chicago 31 • Detroit 2 • Cleveland 16 • Los Angeles 58

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; Passaic, N.J.; No. Charleston, S.C.; Crawfordsville, Ind.; Neenah, Wis.; Raybestos-Manhattan (Canada) Limited, Peterborough, Ontario, Canada

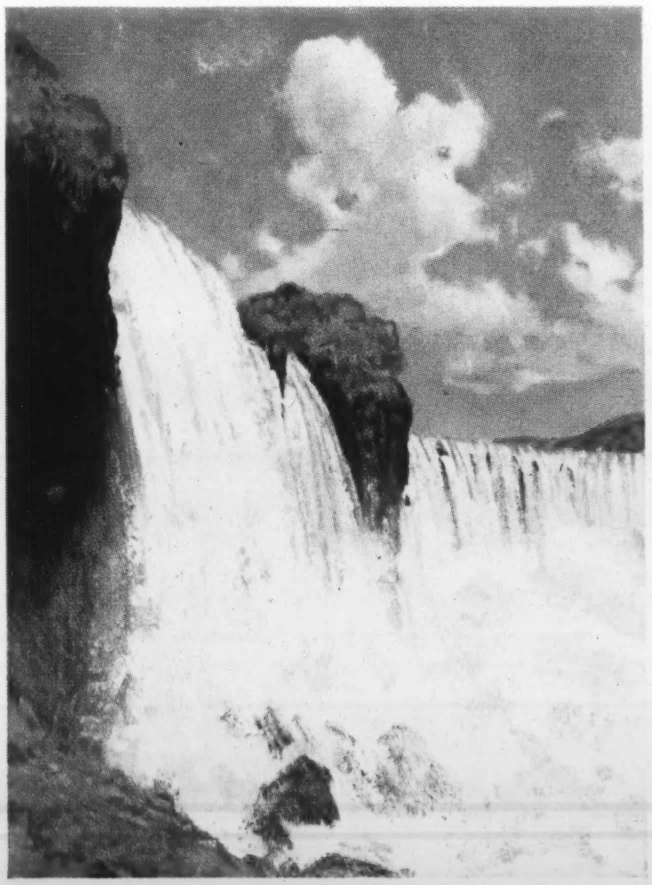
RAYBESTOS-MANHATTAN, INC., Industrial Adhesives • Brake Linings • Brake Blocks • Clutch Facings • Industrial Rubber • Engineered Plastics • Sintered Metal Products Rubber Covered Equipment • Asbestos Textiles • Laundry Pads and Covers • Packings • Abrasive and Diamond Wheels • Bowling Balls

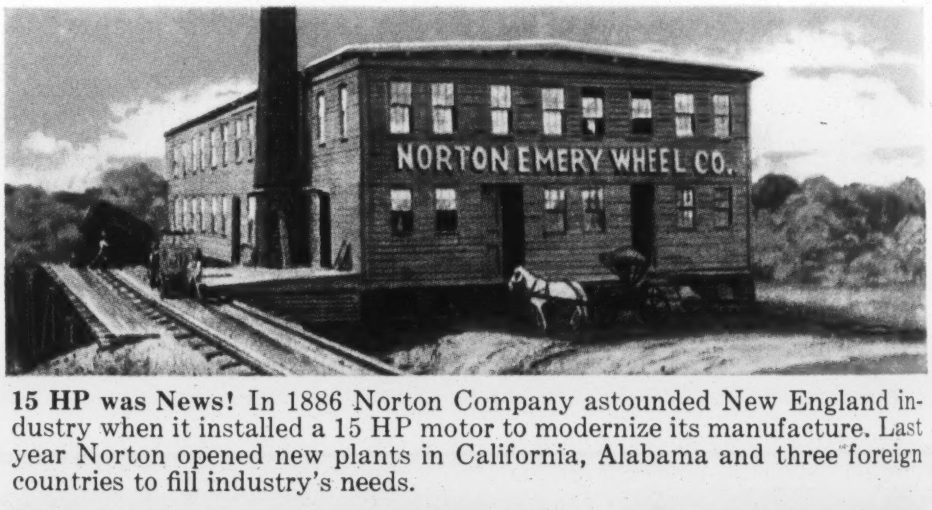
For more information, turn to Reader Service Card, Circle No. 454



This year Norton will use over

533 million KWH to bring



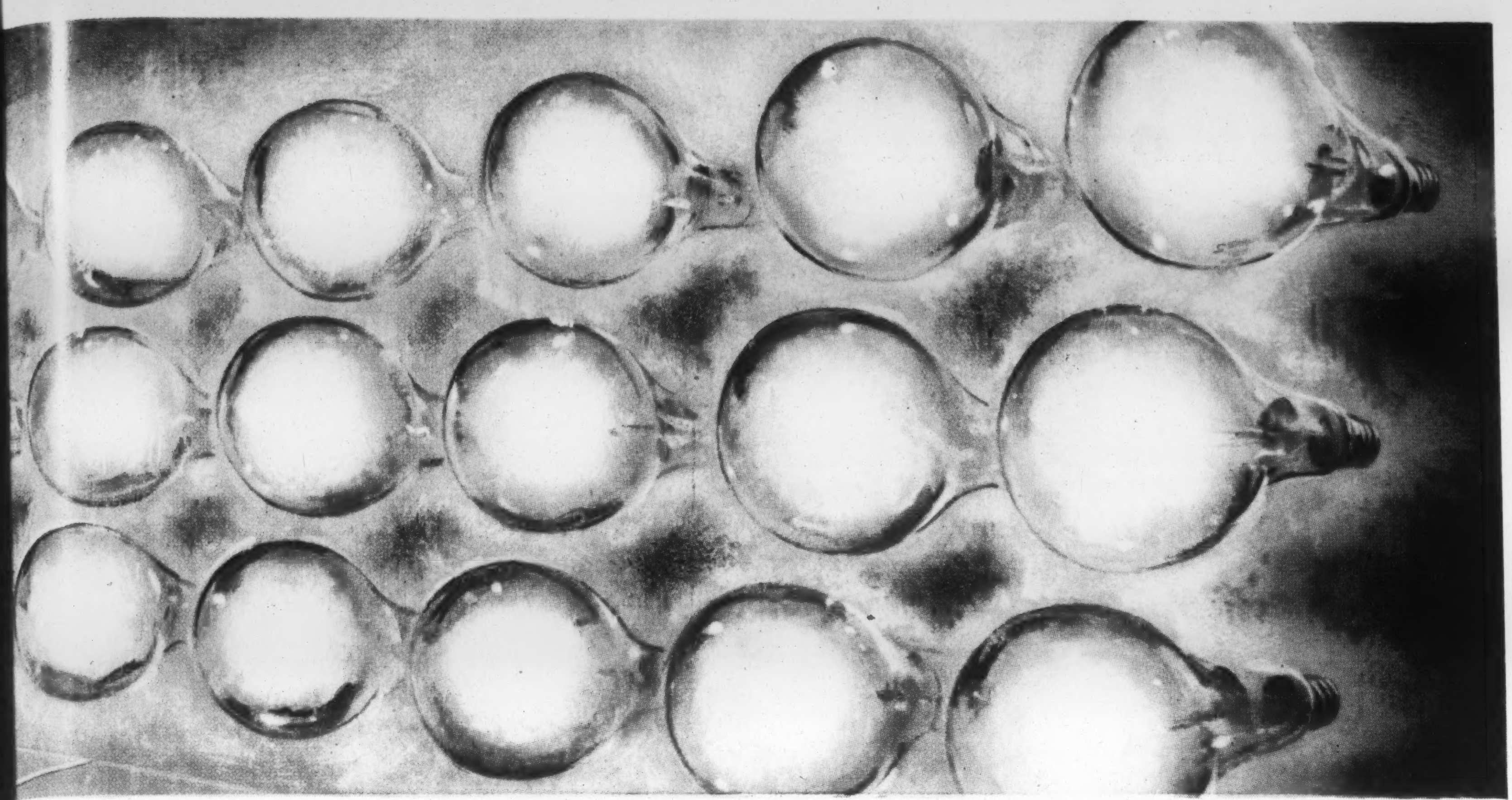

NORTON EMERY WHEEL CO.

15 HP was News! In 1886 Norton Company astounded New England industry when it installed a 15 HP motor to modernize its manufacture. Last year Norton opened new plants in California, Alabama and three foreign countries to fill industry's needs.

Niagara's Power was tapped by Norton Company in 1901 for economical hydro-electric power. Here electric furnaces fuse huge quantities of alumina into Norton ALUNDUM* abrasive.

Electric Furnace Products are a natural outgrowth of Norton research in a multitude of materials fused for greater usefulness and versatility. Nineteen Norton laboratories keep up the daily search for better materials. There's the "Touch of Gold" vein in Norton electro-chemical work, too, if you like.

Making better products...



Each Light Bulb represents 10 million KWH used by Norton Company plants throughout the world in making its abrasives and other Norton products in a single year.

industry the “Touch of Gold”

The now famous Norton “Touch of Gold” is no Midas magic. It is much more complex than that. And, of course, infinitely more certain and more lasting.

“Touch of Gold” is a modern expression for describing the value-adding contribution Norton abrasives make to manufacture. Each time a Norton grinding wheel touches a material in process or sharpens a tool that performs a process it makes some product more useful and more perfect and therefore more valuable.

To give the world’s industries this “Touch of Gold,” you can gauge Norton’s resources by the 533 million KWH it will use this year to make its own products . . . which in turn make your products better.

Norton Company is the world’s largest producer of abrasives, with the largest research and development facilities in this field.

NORTON

ABRASIVES

Ceramic Rokide* Coating helps metals stand up under the higher temperatures encountered in jet planes and rockets. Here ROKIDE is sprayed on a guided missile part. ROKIDE is now being used in many different applications in industry.

Across the world and still expanding

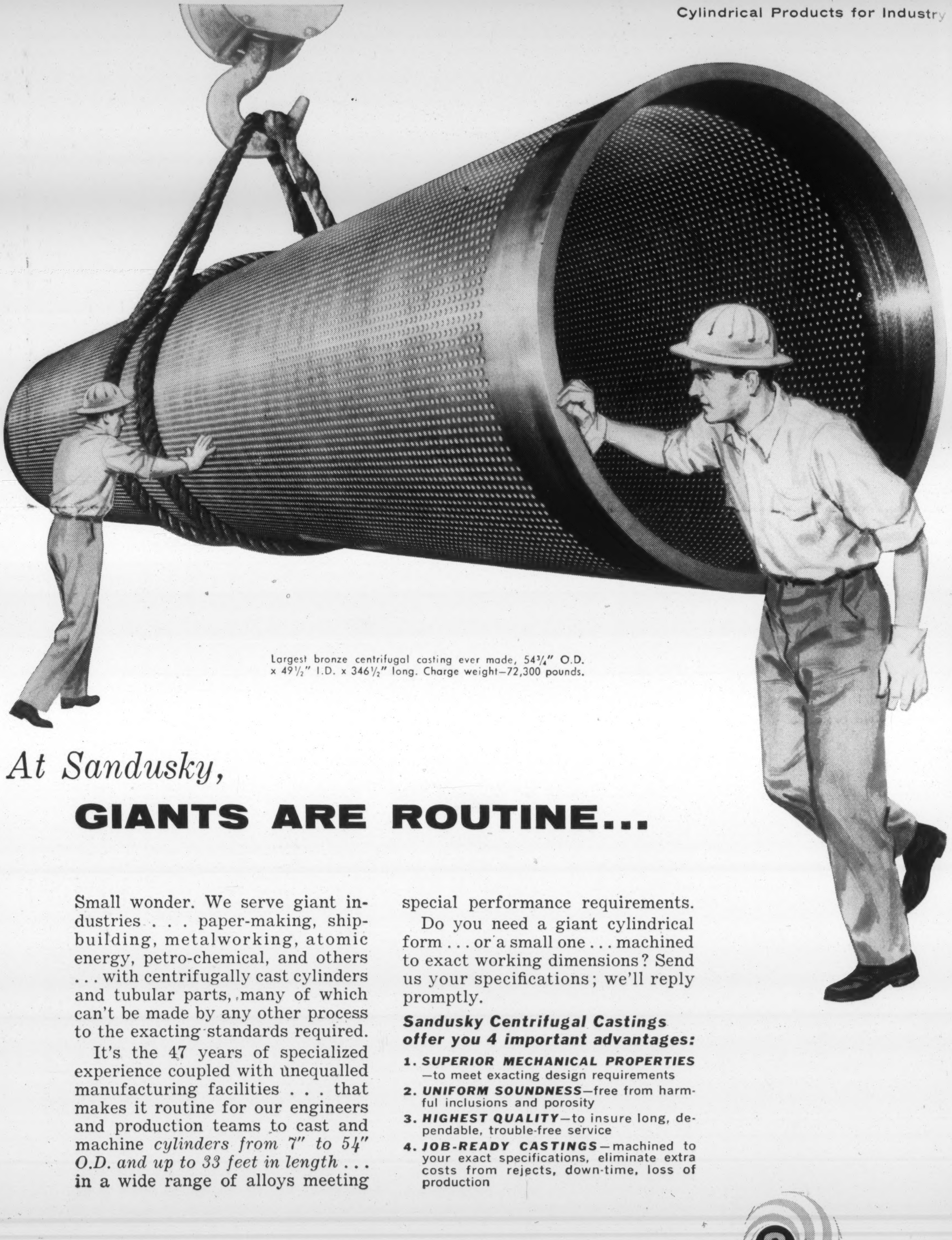
Abrasive and Grinding Wheel Plants—Worcester, Mass.; Santa Clara, Calif.; Hamilton, Ontario; South Africa; England; France; Germany; Italy; Brazil. **Behr-Manning Plants**—*Coated Abrasives and Behr-cat Tapes*—Troy, N. Y.; Canada; Australia; France; Northern Ireland; Argentina; Brazil. **Electric Furnace Plants**—Huntsville, Alabama; Chippawa, Ontario; Cap-de-la-Madeleine, Quebec; Brazil. **Grinding and Lapping Machine Plant**—Worcester, Mass. **Refractories and Electro-Products Plant**—Worcester, Mass. **Norton Pike Plant**—*Sharpening Stones*—Littleton, New Hampshire. **Bauxite Mines**—Bauxite, Arkansas.

General Offices: Norton Company, Worcester, Mass.

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries

to make your products better

Cylindrical Products for Industry



Largest bronze centrifugal casting ever made, 54¾" O.D. x 49½" I.D. x 346½" long. Charge weight—72,300 pounds.

At Sandusky,

GIANTS ARE ROUTINE...

Small wonder. We serve giant industries . . . paper-making, shipbuilding, metalworking, atomic energy, petro-chemical, and others . . . with centrifugally cast cylinders and tubular parts, many of which can't be made by any other process to the exacting standards required.

It's the 47 years of specialized experience coupled with unequalled manufacturing facilities . . . that makes it routine for our engineers and production teams to cast and machine *cylinders from 7" to 54" O.D. and up to 33 feet in length* . . . in a wide range of alloys meeting special performance requirements.

Do you need a giant cylindrical form . . . or a small one . . . machined to exact working dimensions? Send us your specifications; we'll reply promptly.

Sandusky Centrifugal Castings offer you 4 important advantages:

1. ***SUPERIOR MECHANICAL PROPERTIES*** —to meet exacting design requirements
2. ***UNIFORM SOUNDNESS***—free from harmful inclusions and porosity
3. ***HIGHEST QUALITY***—to insure long, dependable, trouble-free service
4. ***JOB-READY CASTINGS***—machined to your exact specifications, eliminate extra costs from rejects, down-time, loss of production

CENTRIFUGAL CASTINGS

Sandusky Foundry & Machine Company

SANDUSKY, OHIO • *Stainless, Carbon, Low Alloy Steels—Full Range Copper-Base, Nickel-Base Alloys*

For more information, turn to Reader Service Card, Circle No. 522

Tool Steel Topics

he Pacific Coast Bethlehem products are sold
Bethlehem Pacific Coast Steel Corporation

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor:
Bethlehem Steel Export Corporation

BETHLEHEM TOOL STEEL ENGINEER SAYS:

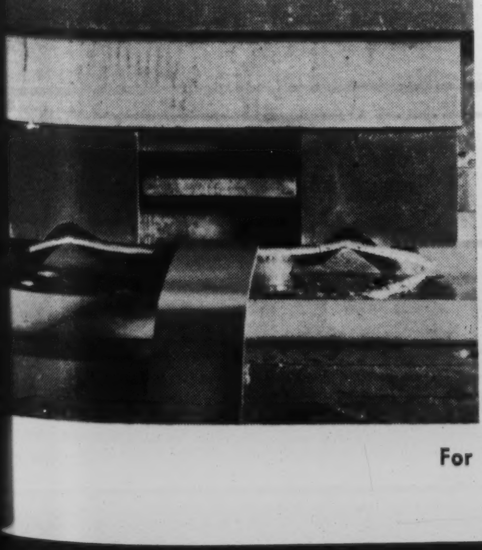
Follow Up With Temper When Drilling Hardened Tools

When necessary to drill holes in hardened tools or dies to incorporate dimensional changes, such drilling is usually done with a triangular drill made of a cast stellite or a sintered carbide. This type of drill operates by generating frictional heat sufficient to locally anneal the steel, so that the cutting edges can scrape the metal away in the path of the drill. All tool steel grades, regardless of how high the hardness developed by heat-treatment, can be drilled in this manner.

It is obvious that such a procedure will produce stresses in tools or dies which, because of heat-treatment, already contain residual stresses. It is important, therefore, that the drilling operation on hardened tools always be followed by a tempering operation. Tempering should be carried out at a temperature equal to, or slightly below, the final temper used in the original heat-treatment operations.

Maker of Beer-Can Openers Likes Economy of Lehigh H

det Manufacturing Corp., San Antonio, xas, needed a strong, long-wearing die r the economical manufacture of beer-n openers. They put the problem up to eir local tool-steel distributor, Earle M. rgensen Co., who recommended Beth-em Lehigh H. "Our experience with s air-hardening grade has shown us w it stands up," the Jorgensen people d. "It's resistant to wear and, besides, s low distortion in heat-treatment."



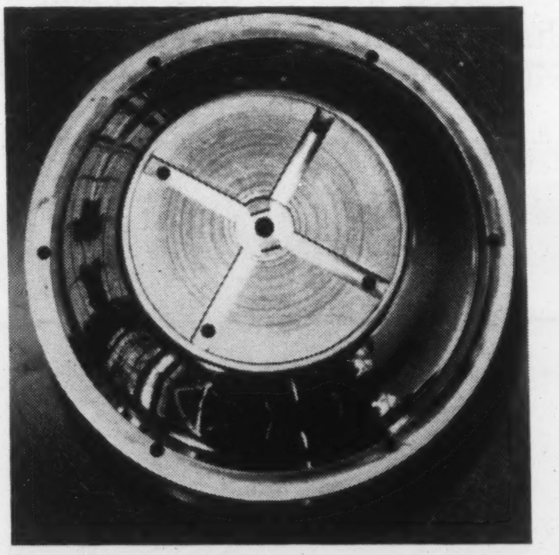
The die was produced by Precision Manufacturing Co., San Antonio, and heat-treated by Cook Heat Treating, Houston. It was placed in service in a 56-ton press in Cadet's shop, where it was fed C 1035 cold-rolled strip, 0.065 in. thick. Performance was excellent, the die performing economically at the high speed at which the press operated. About 800,000 pieces were produced between grinds.

Lehigh H, our high-carbon, high-chromium grade of air-hardening tool steel, is ideal for tough assignments because of its outstanding wear-resistance and toughness. It is well known for its minimum distortion in heat-treatment, and high compressive strength.

TYPICAL ANALYSIS

Carbon	1.55	Molybdenum	0.80
Chromium	11.50	Vanadium	0.40

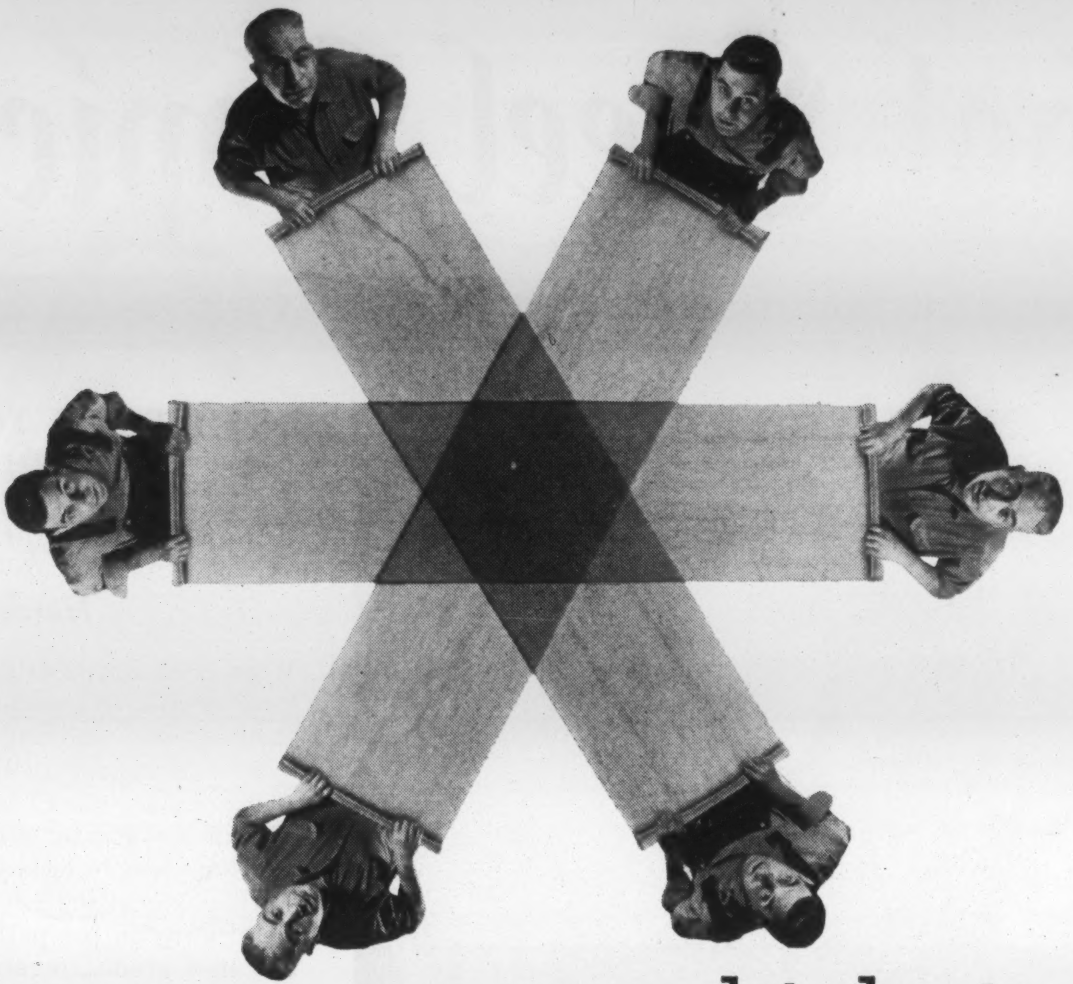
Look into the advantages of Lehigh H by giving it a try. Chances are good that your local Bethlehem tool steel distributor has Lehigh H in stock. Give him a call.



Lustre-Die Provides High Sheen When Making Plastic Parts

This core for a plastic injection mold, made by Interstate Mold & Hobbing Co., Union, N. J., is for use in manufacturing a decorative bowl for household use. It is made of Lustre-Die, an electric-furnace steel of well-balanced analysis, which we alloy-fortify to increase its depth of hardenability and mechanical properties. Use Lustre-Die when you want unusually high sheen on plastic parts. You'll like it.

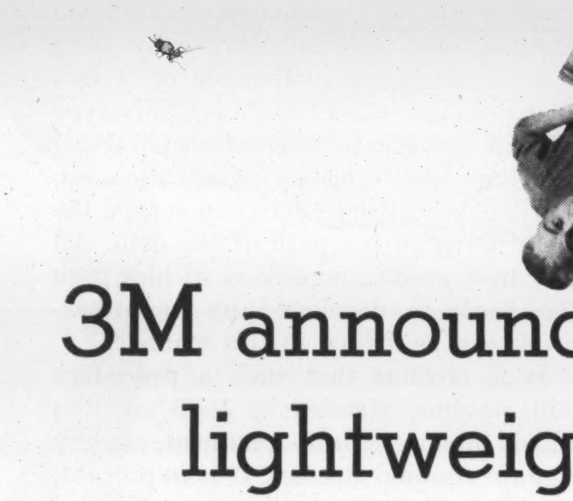
For more information, turn to Reader Service Card, Circle No. 492



3M announces a new high-strength, lightweight structural material

NOW..."Tailor-make" strength for specific stress jobs

"SCOTCHPLY" Brand Reinforced Plastic is a high-strength, moldable, laminated structural plastic reinforced with continuous, non-woven glass filaments. Now, Design Engineers are able to tailor the direction of reinforcements to satisfy specific stress requirements. This versatility is not possible with conventional reinforced plastics using woven glass cloth or short strand reinforcement.



LEAF SPRINGS of "SCOTCHPLY" Brand Reinforced Plastic have higher fatigue-strength than steel and are highly resistant to corrosion and moisture. Here they supply 90% of the operating power for a Carrier "Natural-Frequency" vibratory conveyor.

STRENGTH WHERE NEEDED—Continuous, non-woven glass filaments can be unidirectional, crossplied at 90° in two directions, isotropic at 120° in three directions or arranged in combinations of these directions—depending on stress conditions. Isotropic arrangement (illustrated above) gives equal strength in all directions in the plane of the laminate.

HIGH STRENGTH, LOW WEIGHT—Supplied in uncured sheets or rolls "SCOTCHPLY" Reinforced Plastic has high strength. Weight-to-strength ratio is lower than conventional structural materials, including steel.

EASILY WORKED—Heat and light pressure are all that's needed to cure it. In cured form it can be sawed, machined, sanded, milled, turned, drilled or tapped.

EXCEPTIONAL UNIFORMITY—"SCOTCHPLY" Reinforced Plastic is *mechanically* processed under carefully controlled conditions, eliminates human variables. Its properties can be specified within very narrow limits—unlike other reinforced plastics where *hand* lay-up is necessary.

PLUS—It is a non-conductor . . . has low rate of moisture absorption . . . may be permanently colored or painted . . . gives high resistance to vibration, shock and corrosion . . . has hard, smooth surface.

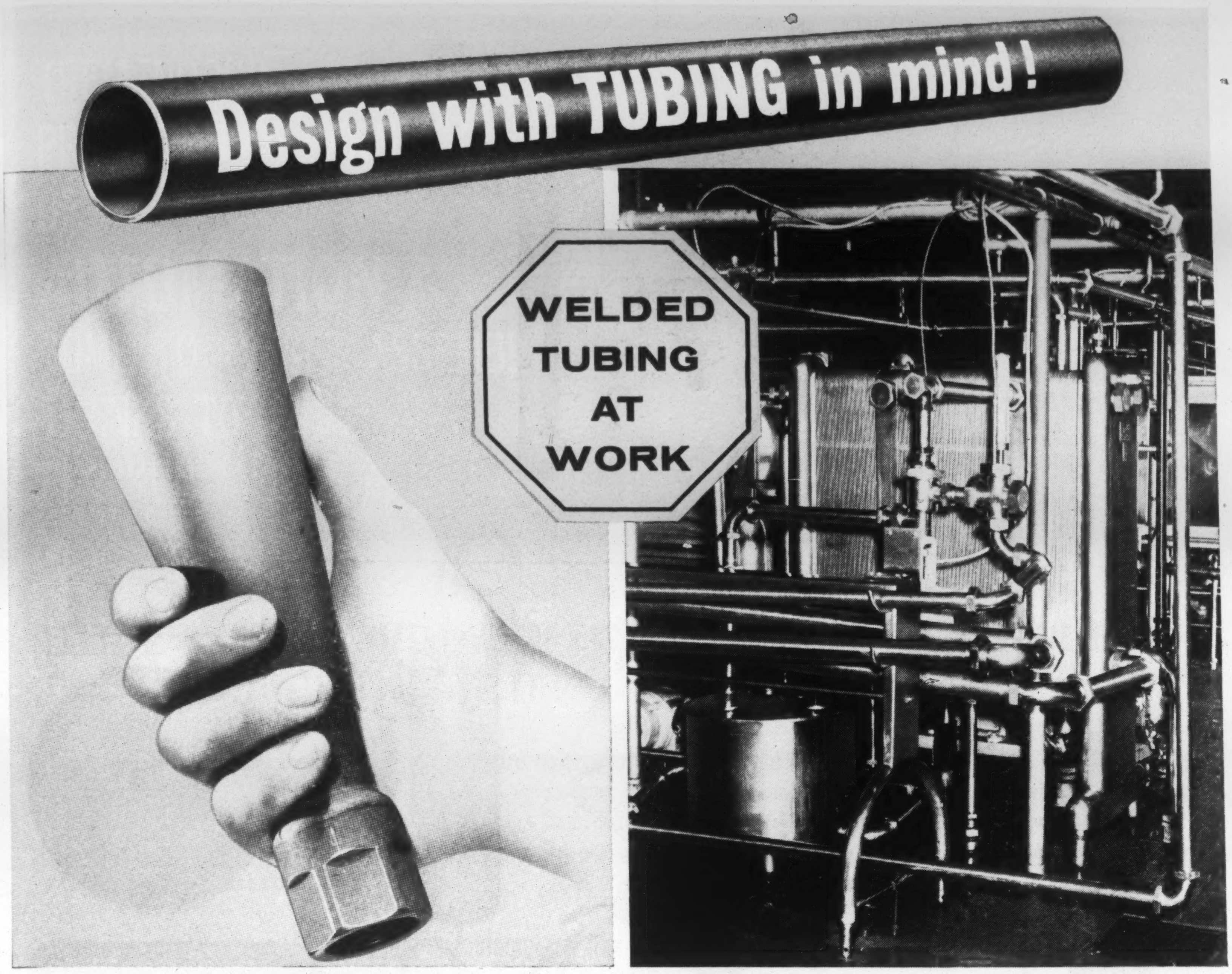
FOR FULL INFORMATION AND TECHNICAL DATA, WRITE MINNESOTA MINING & MANUFACTURING CO., DEPT. PB-67, ST. PAUL 6, MINN.

The term "SCOTCHPLY" is a registered trademark of Minnesota Mining and Manufacturing Company, St. Paul 6, Minn. Export Sales Office: 99 Park Ave., New York 16, N.Y. In Canada: P.O. Box 757, London, Ontario.

PRODUCT OF 3M COMPANY RESEARCH

REG. U. S. PAT. OFF.
SCOTCHPLY
BRAND

For more information, turn to Reader Service Card, Circle No. 423



Once machined from solid bar stock, this machine gun flash hider was produced at a 92% saving in cost by forming from Welded Carbon Steel Tubing.

Positive sanitation, non-contaminating, non-corrosive, non-breakable—all these call for Welded Stainless Steel Tubing in hundreds of Pasteurizers like these and all sanitary services.

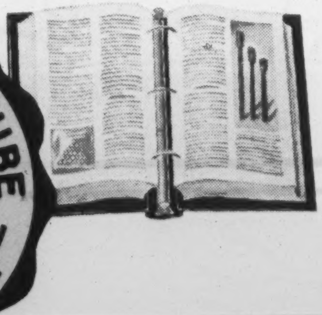
Reduce fabricating costs—Insure purity

CHOOSE WELDED STEEL TUBING

Carbon · Alloy · Stainless Steel

Easy workability, outstanding uniformity, wide range of grades make Welded Tubing applicable to nearly every use requiring a hollow part. Whether a mechanical component, a structural use, to convey liquids or gases, or move at high RPM—there is a grade, size and shape of Welded Tubing that will do your job best. For all tubing applications, consult a quality tube producer.

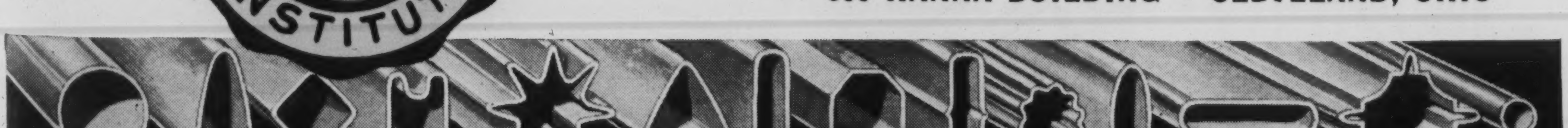
An Association of Quality Tube Producers



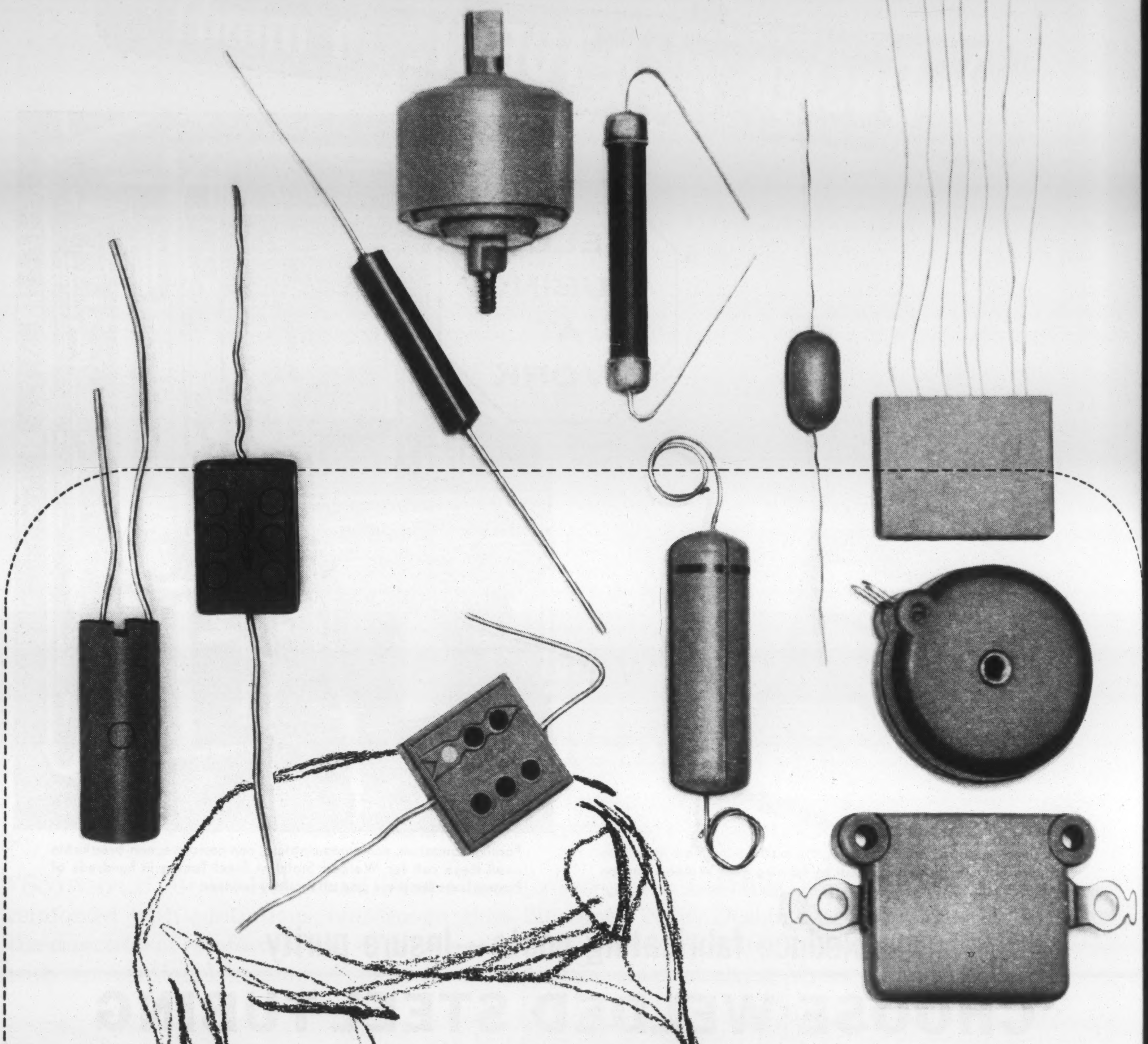
Design inspiration for you

The 260-page Handbook of Welded Steel Tubing contains inspiration and data for tubing designs. For your copy, write on your company letterhead, giving your title.

FORMED STEEL TUBE INSTITUTE
850 HANNA BUILDING • CLEVELAND, OHIO



For more information, turn to Reader Service Card, Circle No. 429



TREMENDOUS PRODUCTION SAVINGS OF **AUTOMATION** COME TO TV SET ASSEMBLY THANKS TO PLASKON® ALKYD

PLASKON ALKYD PUTTY MATERIAL FOR ENCASED COMPONENTS MAKES POSSIBLE FULLY AUTOMATIC FINAL ASSEMBLY!

More and more manufacturers of TV sets are finding that PLASKON Alkyd 417 putty material offers the best combination of physical and electrical properties required for final assembly-line automation. This opens the door not only to substantial savings in production, but to better-performing precision parts as well. Today, PLASKON Alkyds are widely used in the encasement of such important components as capacitors, resistors and toridal coils.

Here's what TV set and component manufacturers like most about PLASKON Alkyd 417 putty material:

UNIFORM DIMENSIONS: Precise dimensional reproduction is possible in molded alkyd parts—assuring greater uniformity than is possible with potting or dipping. Result: symmetry of leads and uniform dimensions of parts to meet the exacting requirements of cost-cutting automatic-assembly equipment.

OUTSTANDING ELECTRICAL INSULATION: PLASKON Alkyd has very high dielectric strength and arc resistance. Because of its excellent electrical insulating properties, Alkyd parts can be made smaller—saving space, cutting cost, improving design.

DEPENDABLE COMPONENTS: Alkyd putty can be wrapped around inserts before molding—and its low-pressure molding requirements and rapid cure do not deform dimensions or change the electrical characteristics of delicate inserts. Alkyd's high heat resistance and dimensional stability help to assure top performance of TV components and other electronic and electrical parts.

OTHER TYPICAL TV APPLICATIONS OF PLASKON ALKYDS:

1. *Tuner Board* (Alkyd 430): extreme dimensional stability; uniform, close tolerances; high rate of production.
2. *Tuner Segment* (Alkyd 420): saves machining costs; gives increased electrical and moisture resistance.
3. *Power Tube Socket* (Alkyd 422): permits rapid mass-production schedules; has high dimensional stability.

If *you* are having performance problems that might be solved by better electrical insulating materials . . . you should know more about PLASKON Alkyds. *Write today* for complete information!

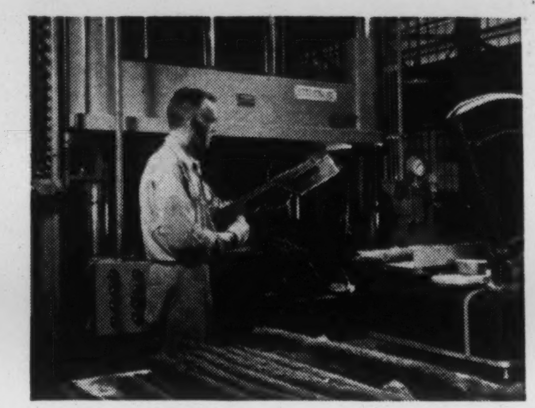
BARRETT DIVISION, Allied Chemical & Dye Corporation, 40 Rector Street, New York 6, N. Y.

Allied Chemical

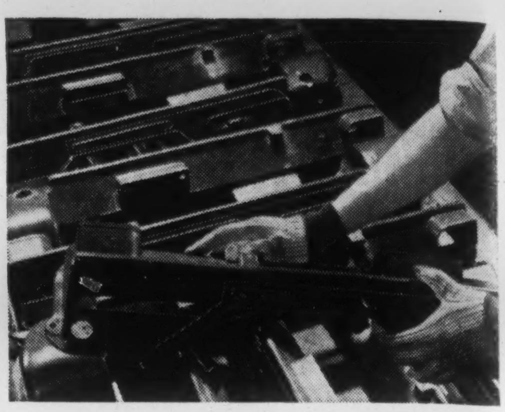
Barrett PLASKON®

For more information, turn to Reader Service Card, Circle No. 466

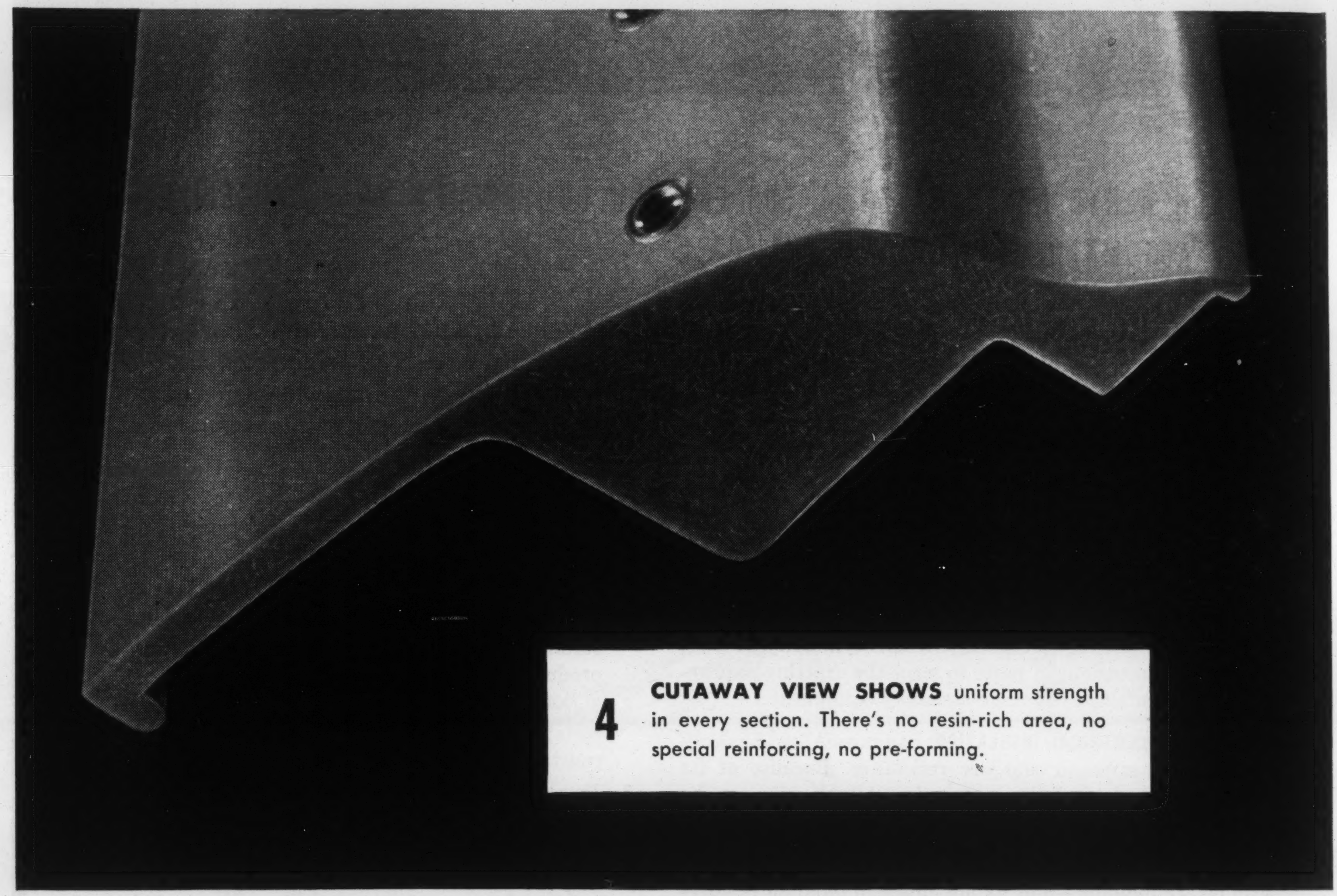
1 This premix consists of reinforcing material, such as fiber glass or sisal, thoroughly mixed with polyester resin containing Dow Styrene.



2 The premix molding compound flows evenly to each and every section of the closed die as it is compressed under heat and pressure.



3 After a very short cycle, the finished premix molding is removed from the die. It is now ready for immediate assembly or shipment.



4 **CUTAWAY VIEW SHOWS** uniform strength in every section. There's no resin-rich area, no special reinforcing, no pre-forming.

For lower bids: premix moldings

For uniform strength: polyester resin with Dow Styrene

Many complicated parts—especially parts with varying wall thicknesses—are now made better, at lower cost, by premix molding. There are no resin-rich areas. Strength is uniformly distributed. Pre-forming is eliminated. And holes and nozzles can be molded in a part, eliminating punching and drilling operations.

Leaders of the automotive and appliance industries have proved the benefits of premix moldings for specific parts. Many innovations are now on the drawing boards.

The product shown is an example of the many now being made by premix molding using Dow Styrene. For technical assistance on Dow Styrene, write THE DOW CHEMICAL COMPANY, Midland, Michigan – Plastics Sales Department PL1886F.

Photographs through the courtesy of Fabricon Products, River Rouge, Michigan

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Custom molders and manufacturers alike are currently accounting for millions of pounds of FIBERFIL Nylon G and FIBERFIL Styrene G — in applications which could not be mastered with ordinary plastics. And every day brings an ever-greater demand for these most versatile *glass-reinforced* injection molding compounds.

Whatever the product or part, however close the tolerances or however exacting the requirements for durability and rigidity, don't decide it can't be injection-molded until you investigate FIBERFIL! Write for complete data *today.*

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how durability of ARMASTEEL® PISTON applications in

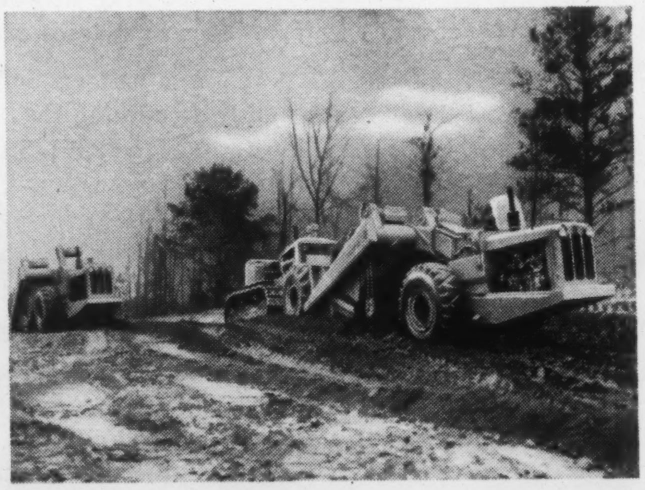
In thousands of applications—in millions and millions of hours of operation—Detroit Diesel engines with ArmaSteel pistons have proved repeatedly their ability to stand up under any task.

In the original design of the Series 71 Detroit Diesel engine in 1937, much thought was given to the piston material. Aluminum pistons were susceptible to burning out. Gray iron, even the high alloy types, did not have sufficient strength or endurance for diesel service. Finally after exhaustive tests Central Foundry's pearlitic malleable iron—ArmaSteel—was found to be the ideal material. It did not burn out and it had exceptional endurance.

Through the years the horsepower of the Series 71 periodically increased until today it has twice the power of the original engine and this without increasing the size of the engine or the number of cylinders. And ArmaSteel Pistons in spite of the higher operating loads and extreme temperatures, are still performing flawlessly. As a result, ArmaSteel pistons are now standard in all Detroit Diesel engines.

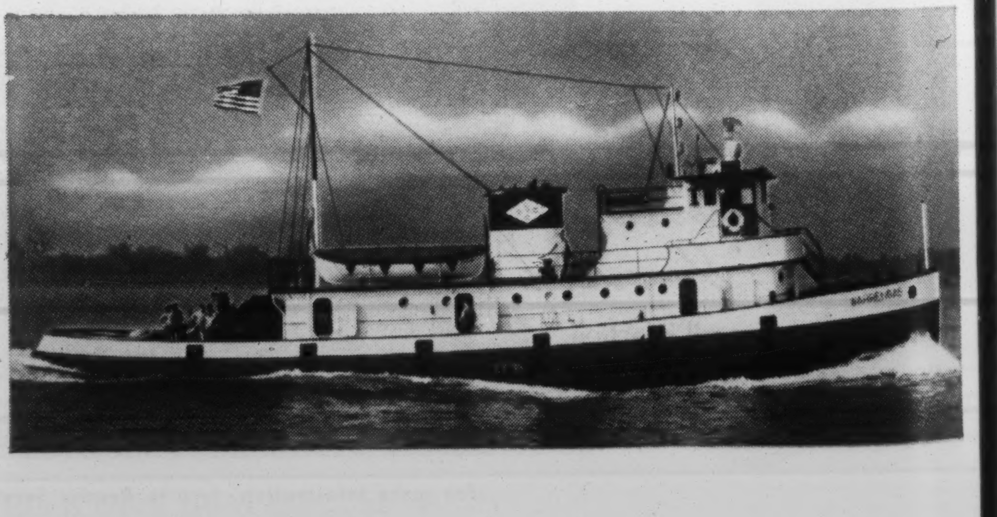
As in these dependable Detroit Diesel engines, your product may be improved by the advantages of ArmaSteel's unmatched qualities of machinability, uniformity, high yield strength, excellent bearing properties . . . and the other remarkable characteristics of this pearlitic malleable iron.

This Diesel piston is cast and machined from grade 86 M ArmaSteel which provides a fine combination of high strength and machinability. Tensile strength is 70,000 psi. (double that of grade A cast iron). Yield is 48,000 psi. Because of ArmaSteel's structure the machinability rating is 95% that of S.A.E. 1112!



Heavy-duty scrapers (above, right) like this can scoop up and evenly distribute 20 cu. yds. at one sweep. They are dependably powered by Detroit Diesel engines with sturdy ArmaSteel pistons.

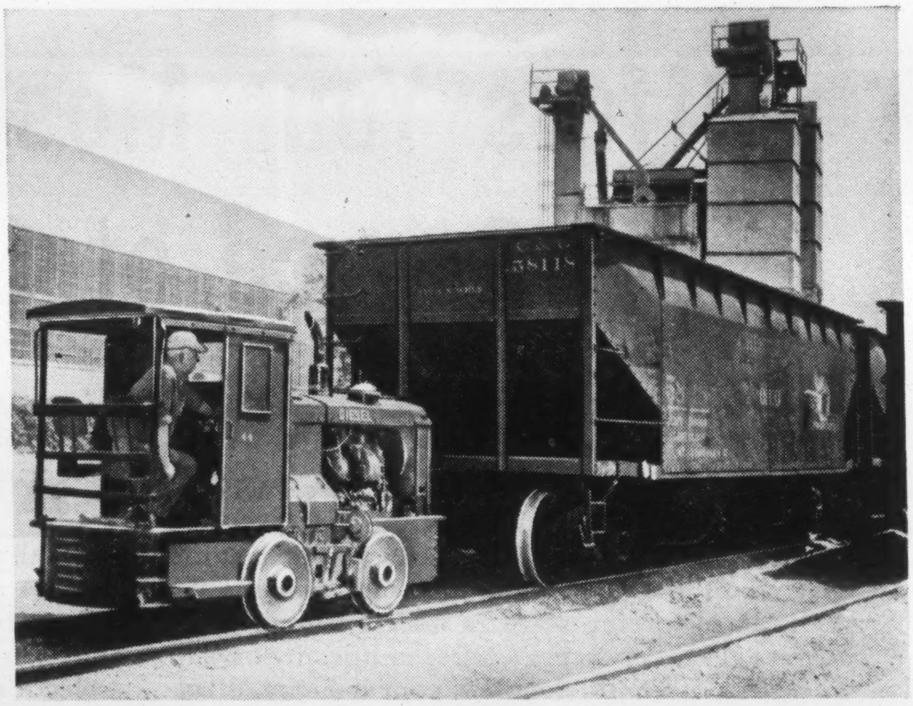
Always impressive workers, diesel shovels and trucks such as these (above) provide further proof of ArmaSteel pistons' great strength and long fatigue life.



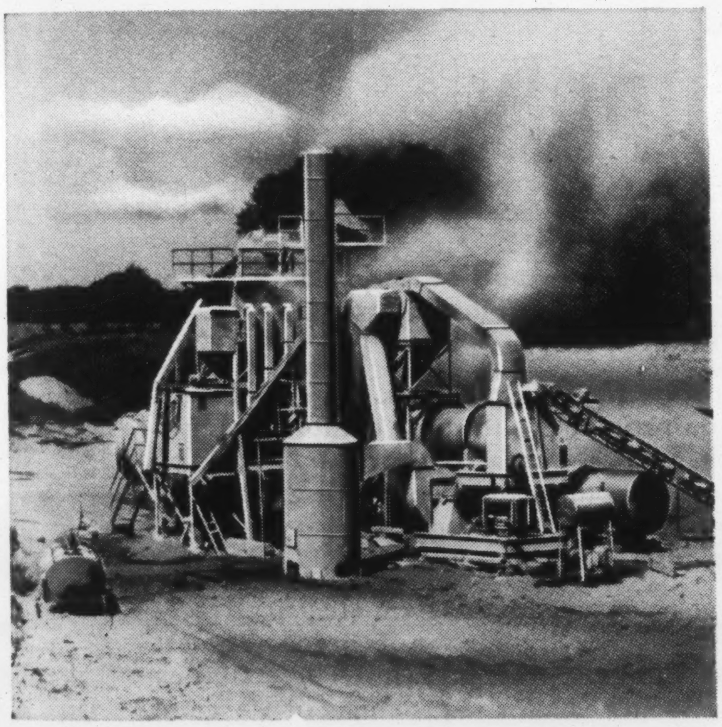
Seagoing tugs (right) with Detroit Diesel engines give ArmaSteel pistons a chance to prove their amazing fatigue life, since this application calls for an engine which is built to provide long hours of steady, unremitting service.

is proven in tough DETROIT DIESEL Engines

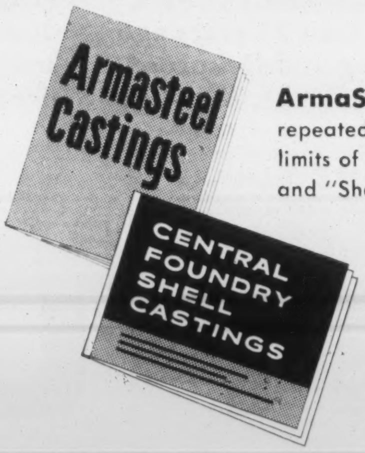
Fleet, smooth-powered giants of city streets and highways, these heavy busses subject their Detroit Diesel engines to violent speed changes, rapid load variations. In these applications, the ArmaSteel pistons prove that they are practically impossible to wear out (records show many busses run from 300,000 miles up to 550,000 miles without engine overhaul).



Dubbed "the Mighty Midget", this 8-ton yard locomotive—scarcely larger than a handcar—moves as many as 12 cars at once. The 3 ArmaSteel pistons in its power plant help it maintain its amazing power thru long hours of service.



At this portable asphalt plant, where inaccessibility to utility power lines makes diesel power mandatory, a single generator, driven by a twin-6 GM Detroit Diesel engine furnishes power for 10 electric motors.



ArmaSteel: a triumph of modern metallurgy, is repeatedly proving that it is far from reaching the limits of its versatility. These 2 free books, "ArmaSteel" and "Shell-castings", will help you discover how Central Foundry can serve you. Write for your copies.

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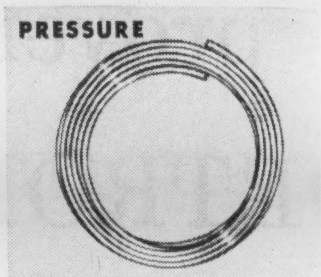

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World's Largest Producer of SPECIALTY WELDED TUBING Offers Your Most Complete Source of Supply

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Manufactured at the Steel and Tubes Division, Republic Tubing is welded by the ELECTRUNITE Process . . . a Continuous Electric Weld method that unites the wall under pressure without the addition of foreign or extra metal. Among other advantages this process assures uniformity of wall thickness, strength, ductility, concentricity, diameter and physical and mechanical properties.

Republic, the pioneer in this improved welding technique, is proud of its many "firsts" in the industry. In addition to introducing ELECTRUNITE® Boiler Tubes to the trade more than 25 years ago —plus Electrical Metallic Tubing and Dekoron®-Coated E.M.T. to the electrical industry, Republic was the first to provide a non-destructive electronic production method of testing tubing used for critical pressure applications, known to the trade as FARROWTEST®.

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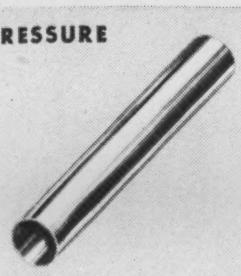

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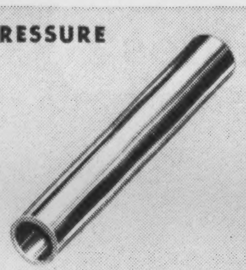

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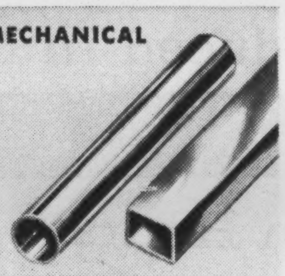

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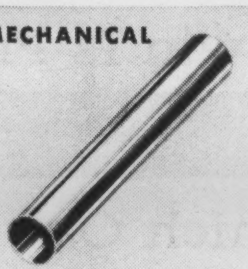
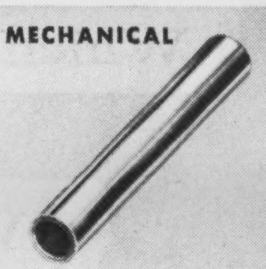


ORNAMENTAL—Type 302—Not Annealed—Not Pressure Tested

MECHANICAL



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⅛" O.D. THROUGH 5" O.D.

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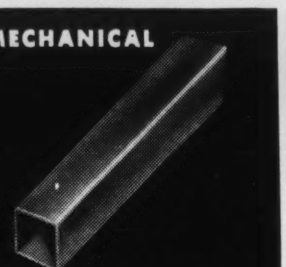

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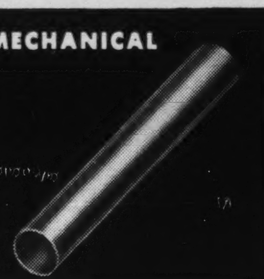

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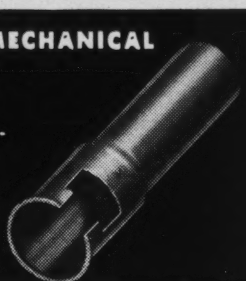

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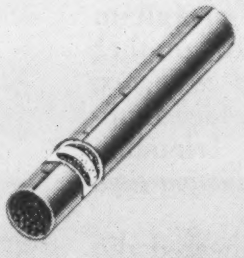
E.M.T. ⅜" THROUGH 2"—RIGID STEEL CONDUIT ½" THROUGH 6"



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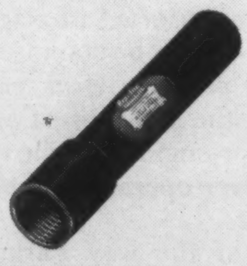
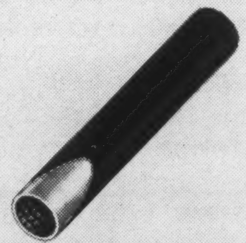
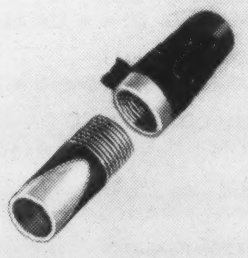


RIGID STEEL CONDUIT—ENAMELITE®—½" thru 6"

RIGID STEEL CONDUIT—GALVITE®—½" thru 6"



DEKORON®-COATED E.M.T. A Plastic Armored Electrical Raceway—½" thru 2"



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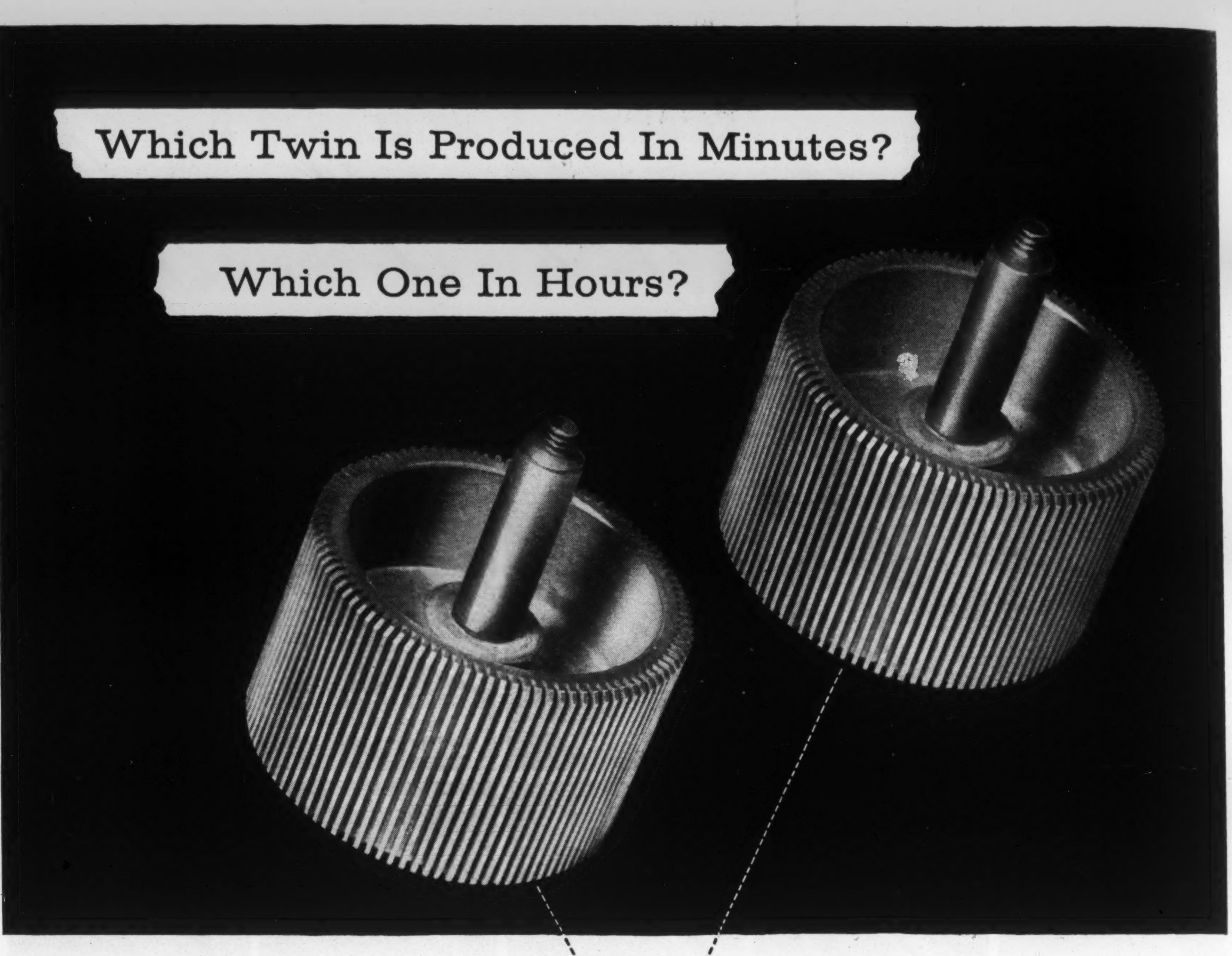

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These parts are identical. One, however, is produced in minutes, the other in hours. Parker-engineered die casting makes the difference.

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This skill and experience can solve problems—and save money—on *your* components parts. Just call the nearest Parker sales engineer or write the factory direct.

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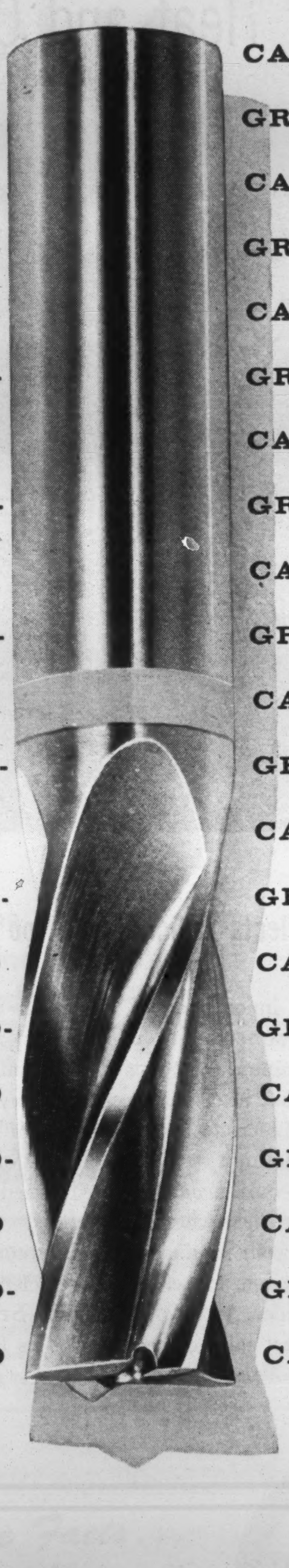

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Electro-Grinding eliminates checked, chipped or flaked cutting edges caused by the strains and high temperatures of other production methods. With the extra fine grit wheels used by Elgin, Electro-Grinding assures the sharpest, smoothest cutting edges yet.

Use Elgin Golden Circle Carbide End Mills for more production hours between regrindings, for greater accuracy and lower tool costs. Write today for the complete new catalog. It shows Elgin's complete line of solid carbide end mills, drills, reamers and burs—all in stock for immediate delivery.

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...Resists Combined Attack of Heat and Corrosion
...Directs and Saves Heat

Truck mufflers made of ALUMINIZED STEEL increased service life five times

Here's a typical example of the extra product life offered by Armco ALUMINIZED STEEL® Type 1 . . . the special steel that withstands destructive combinations of heat and corrosion:

A major truck fleet in Nashville, Tennessee, reports *five times longer service life* for mufflers made of ALUMINIZED STEEL than for carbon steel mufflers previously used.

Many products besides mufflers have also been improved by this special steel. Parts of heaters, furnaces, stoves and ranges—serving where heat and corrosive gases make short work of plain carbon steels—last longer when they're made of Armco ALUMINIZED STEEL Type 1.

Reflects radiant heat, too

The inner body of this rotisserie is made of Armco ALUMINIZED STEEL Type 1 because, up to 900 F, this aluminum-coated steel reflects about 80 per cent of the radiant heat that meets it. Many manufacturers design appliances to take advantage of this reflectivity as well as the high strength of ALUMINIZED STEEL. Depending on requirements, it may be used to hold heat in, or to direct heat where it's wanted.

If your products must resist combinations of heat and corrosion, or reflect heat efficiently, it will pay you to consider Armco ALUMINIZED STEEL Type 1. Call our nearest sales office or write us for full information at the address below.

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HIGH-IMPACT THERMOPLASTIC RESIN

in the new EKCO FLINT "1900" line of kitchen tools, egg beaters and cutlery?

The answer is simple:

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CYCOLAC has the very basic material properties you are looking for: Rugged toughness plus light weight . . . Bright colors accented by high gloss . . . Excellent impact-resistance combined with a high in heat-distortion temperature plus a low brittle point.

CYCOLAC has greater dimensional stability . . . wonderful electrical properties and is easily injection-molded, extruded or calendered.

CYCOLAC is resistant to many oils, solvents and corrosive chemicals . . . capable of being colored to hundreds of opaque shades . . . and can be readily machined.

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MARBON CHEMICAL . . . *Precision Resins for Precision Made Products*

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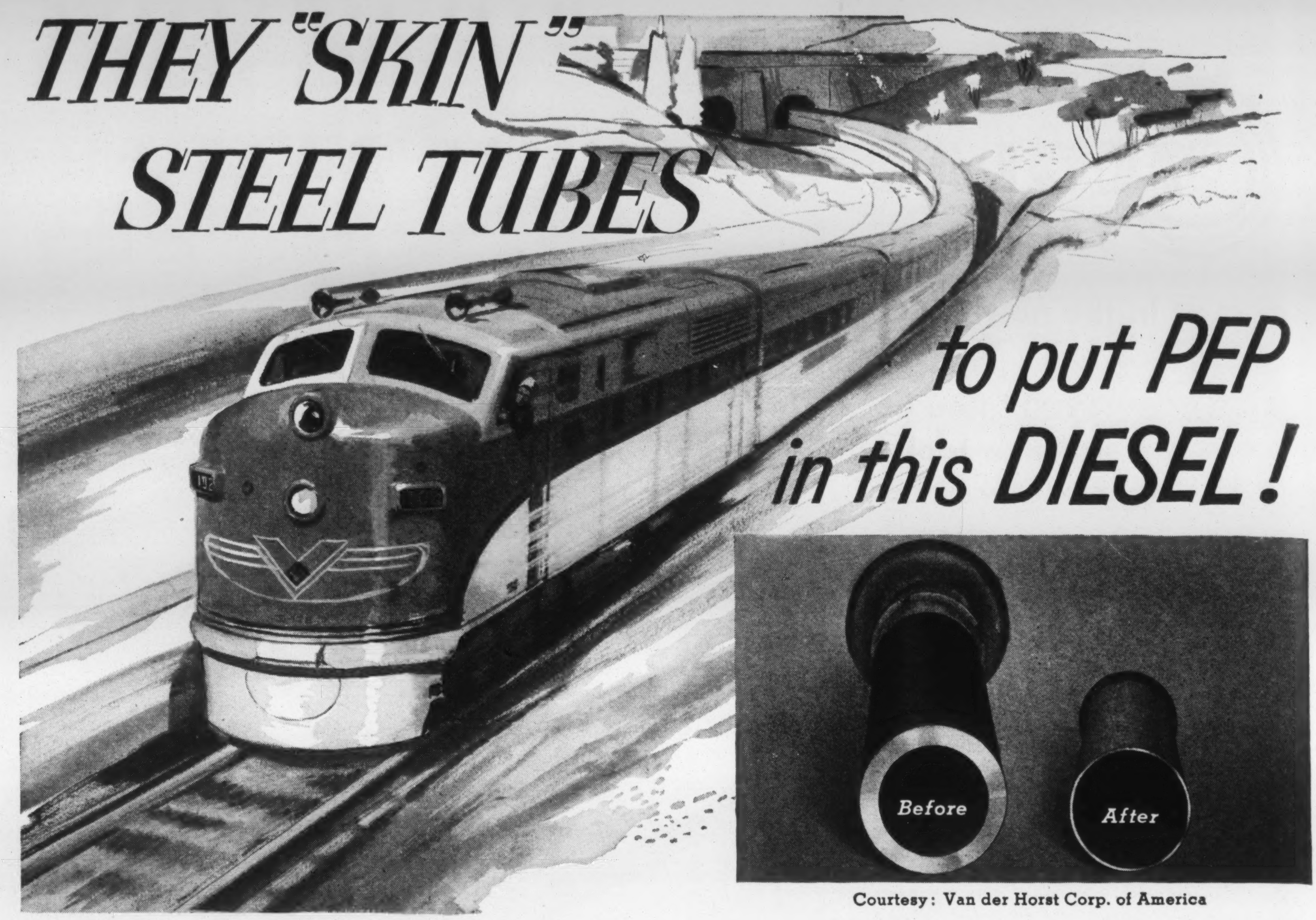
THEY "SKIN" STEEL TUBES

to put PEP in this DIESEL!



Courtesy: Van der Horst Corp. of America

This powerful diesel loses its pep when cylinder liners become excessively worn. Formerly, this reoccurring ailment called for reboring — an operation that reduced the liner wall and its mechanical strength. In time, costly castings had to be scrapped. Now — a unique application of Frasse tubing helps put them back in service . . . indefinitely! Here's how.

By means of a newly developed electrolytic bath, the bore of the worn liner is plated with a precise layer of pure iron etched from the surface of a steel tube. It is then restored to original size — ready for service again.

The success of this precision plating operation depends on quality tubing that is dimensionally uniform. Frasse tubing — from warehouse stock — has met this rigid requirement for many years *without a single rejection.*

There is no fear of non-uniformity when you work with Frasse tubing. You get the same trouble-free quality with every order. And, remember Frasse tubing specialists are available to consult with you in applying tubing to your product advantageously, or in solving a tube problem. Whenever you need tubing — you'll be pleased with the extra services you get — simply by calling Frasse.

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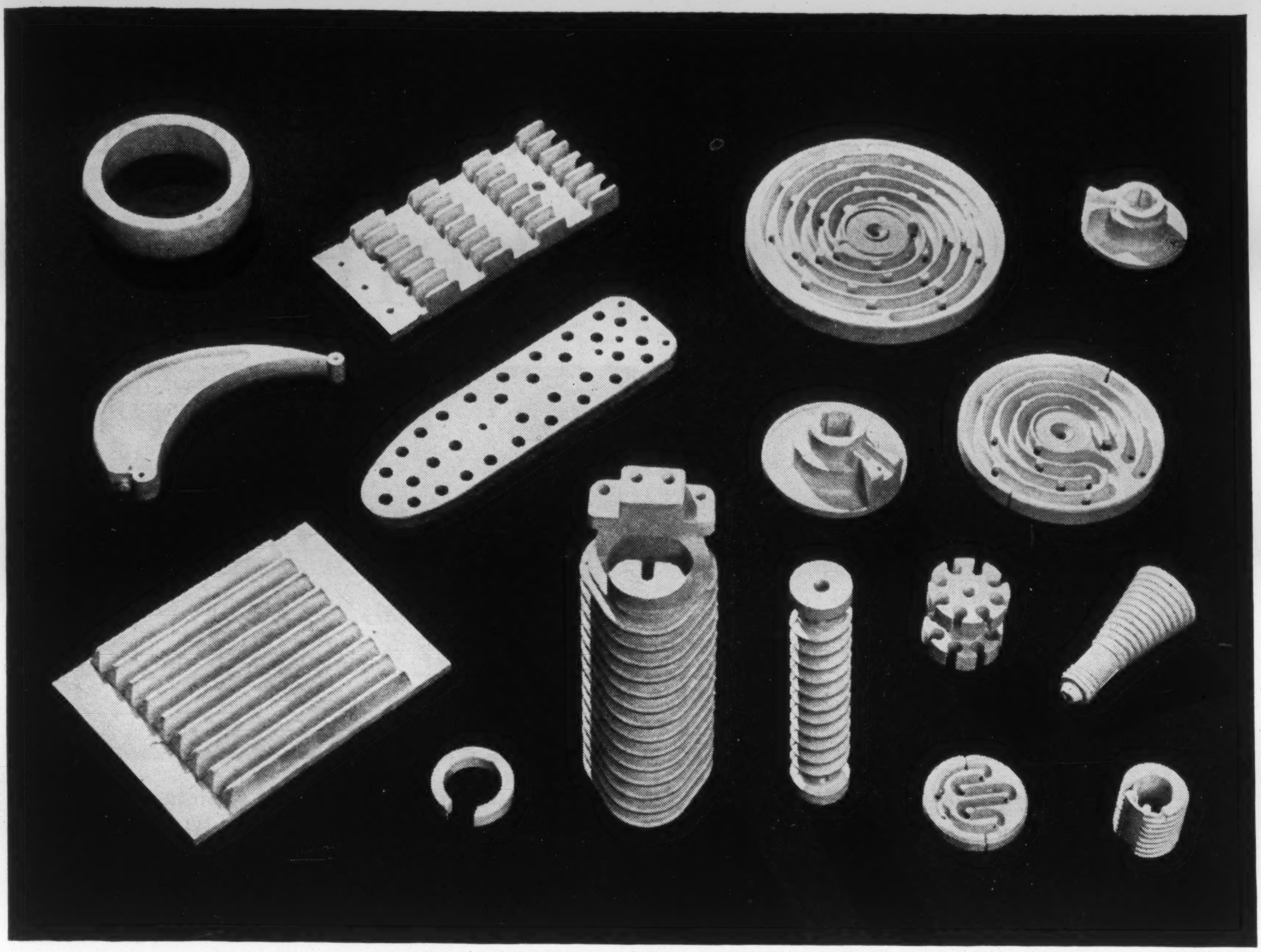
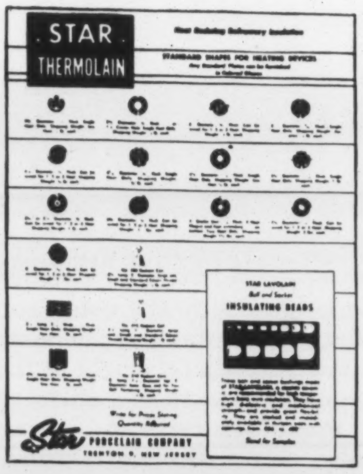


when the heat's on . . .



STAR THERMOLAIN

STANDARD SHAPES FOR HEATING DEVICES

STAR LAVOLAIN
Ball and Socket
INSULATING BEADS

Send for Samples

Write for Prices Stating Quantity Required

Star PORCELAIN COMPANY
TRENTON 9, NEW JERSEY

WANT THE FACTS?

Standard refractory shapes are shown on our new data sheet together with sizes, weights and other pertinent engineering data. Write for a free copy today!

. . . you can really depend on Star THERMOLAIN® refractory porcelain for exceptional performance in *any* electrical heating device you manufacture . . . broilers, radiant heaters, ranges, water heaters, roasters, coffee-makers, air heaters, rheostats, immersion heaters . . . hundreds more!

Star THERMOLAIN offers good mechanical strength *plus* excellent thermal shock resistance . . . a combination that means long, trouble-free heating-element life and user satisfaction. Remember the name . . . Star THERMOLAIN . . . it's synonymous with quality products. The Star Porcelain Company, 39 Muirhead Avenue, Trenton 9, New Jersey.

N. Calif. & Pacific N.W. Representative:
Thermo Materials Inc., 44 Encina, Palo Alto, Calif., DAvenport 6-2780

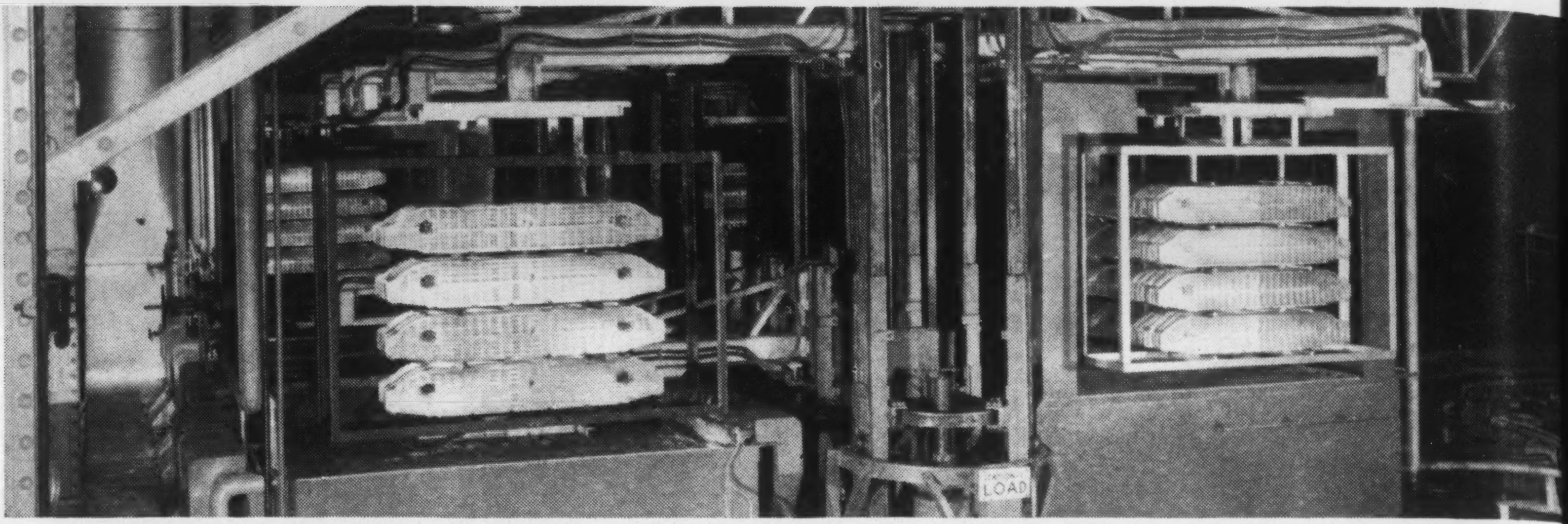
Los Angeles Area Representative:
Edwin E. Starr, 4101 Rhodes Ave., N. Hollywood, Calif., STanley 7-5879

the STAR
porcelain company

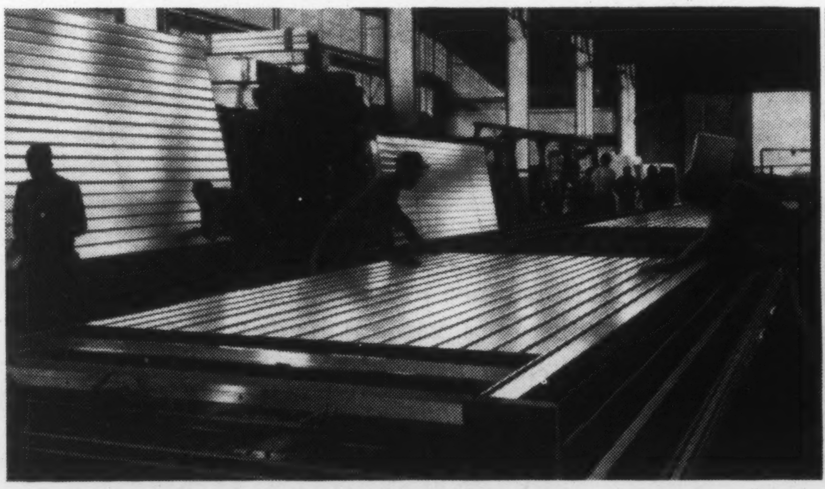
For more information, turn to Reader Service Card, Circle No. 367

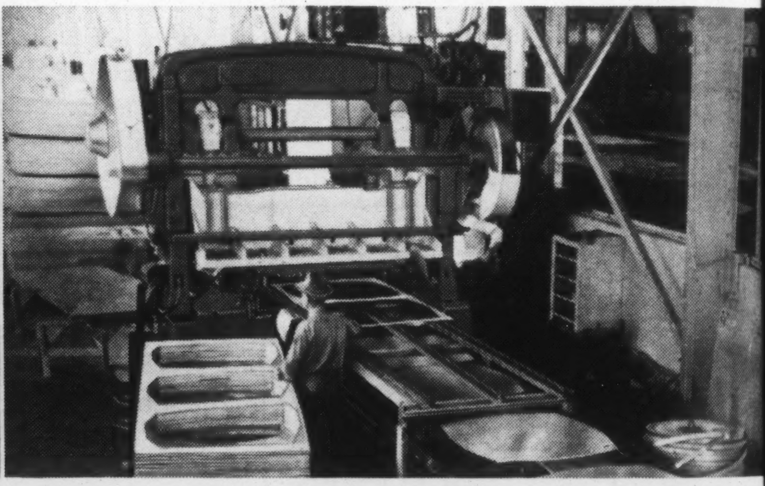
Parts for the products *you design* can be economically fabricated and

here are 7



1 Reynolds ADDS TO YOUR CAPACITY WITHOUT INCREASING COSTS
Reynolds great variety of specialized equipment assures you the economy of the equipment best suited to your purpose. This can save you important capital investments in equipment and added plant capacity. The new Reynolds automatic aluminum finishing system above—shown gold anodizing automobile grilles—can finish mixed sizes and types of parts and chemically brighten or anodize them in different colors—and can handle several different jobs at the same time. An automatic coding system establishes the individual finishing specifications for each job.





2 Reynolds CUTS YOUR MATERIAL HANDLING COSTS
Reynolds assembling of the aluminum siding panels for truck subassemblies above is saving money for a truck-trailer manufacturer. Whether you make telephone booths, portable TV cabinets or a host of other products, you'll cut your handling costs by getting parts from Reynolds. Reynolds also takes the problems of scheduling, material supply, labor and machine availability off your hands.

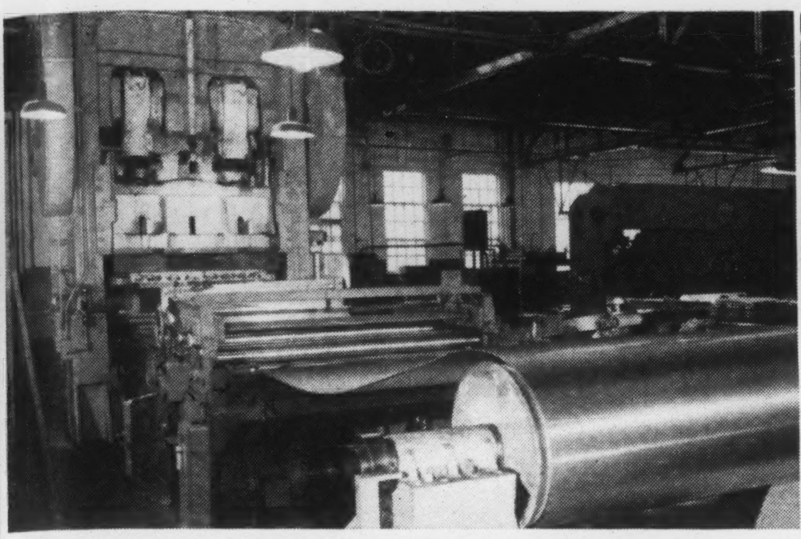
3 Reynolds CUTS YOUR SCRAP LOSS AND HANDLING COSTS
The aluminum blanks on the conveyor are ready to go to an appliance manufacturer. The scrap beside the press is remelted immediately right at the Reynolds plant. Thus Reynolds Aluminum Fabricating Service saves you—the manufacturer—an average of 30% scrap loss and also eliminates costly time and labor scrap handling expense on your part in sorting, storing and shipping.

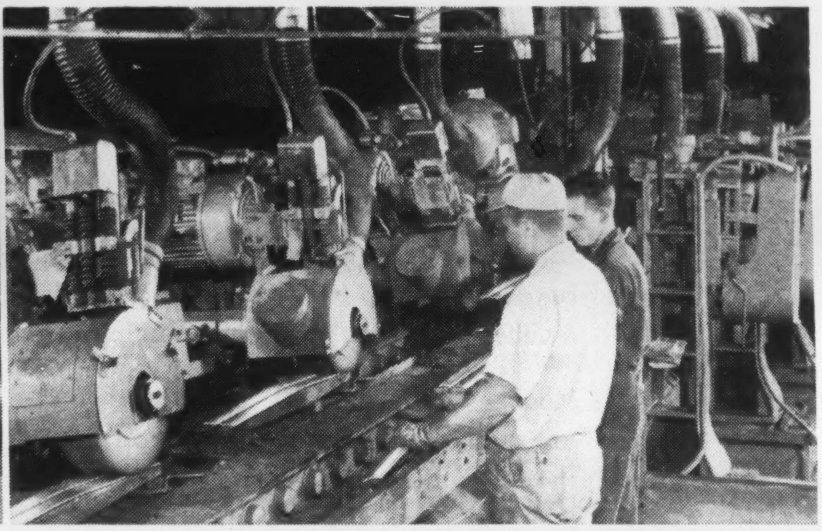
For details on Reynolds fabricating and finishing facilities write for your copy of Reynolds "Complete Facilities" brochure. And for the assistance of Reynolds Styling and Engineering Service, contact your nearest Reynolds Office or write to the address on the facing page.

The Finest Products
Made with Aluminum
are made with
REYNOLDS ALUMINUM

finished by Reynolds

good reasons why



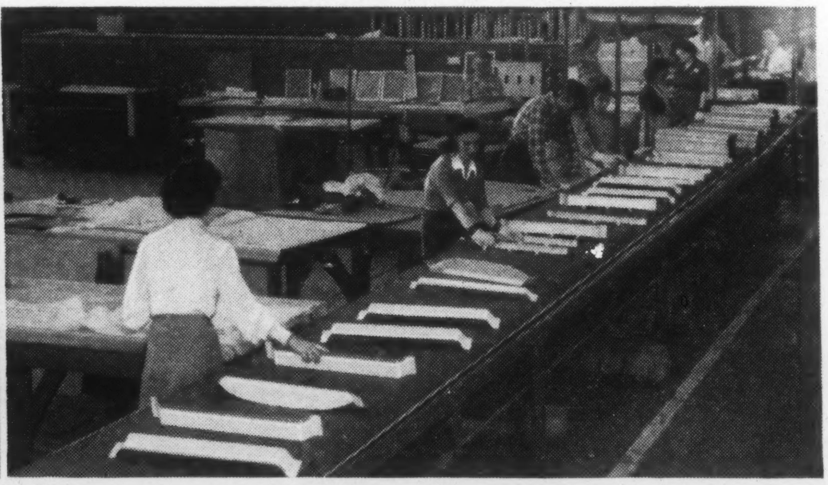


4 Reynolds REDUCES YOUR RAW MATERIAL INVENTORY

You get *pounds of parts* instead of pounds of metal when you use Reynolds Aluminum Fabricating Service. Like the manufacturer who will receive the parts in work on these high speed coil fed presses, you too can save by cutting out that costly part of your metal inventory that does not go into finished parts.

5 Reynolds RELEASES YOUR VALUABLE FLOOR SPACE

Equipment such as Reynolds new high speed buffing machines above, plus stocks of raw materials, take up valuable floor space. Imagine the space you can save in your plant—space you can put to profitable use—when you rely on Reynolds to produce quality aluminum components for your products.



6 Reynolds OFFERS YOU DELAYED MATERIAL BILLING

You receive 100% of your aluminum in finished parts when you use Reynolds Aluminum Fabricating Service. And, as these parts are generally billed after assembly into finished products, no investment is tied up in raw metal. Roll forming machines are but one example of the more than 200 pieces of major fabricating and finishing equipment offered by Reynolds in two plants alone.

7 Reynolds ELIMINATES YOUR REJECT COSTS

Reynolds Aluminum Fabricating Service does away with your machine and labor production losses and inspection expense in rejects, because you pay only for finished, inspected parts. The conveyor line above, where finished aluminum parts are carefully inspected before packing and shipping, is just one of the many examples of Reynolds quality control from mine to finished part.

See "CIRCUS BOY", Reynolds exciting dramatic series, Sundays, NBC-TV

REYNOLDS ALUMINUM
FABRICATING SERVICE
2060 South Ninth Street, Louisville 1, Kentucky

BLANKING • EMBOSSING
STAMPING • DRAWING
RIVETING • FORMING
ROLL SHAPING • TUBE
BENDING • WELDING
BRAZING • FINISHING

For more information, turn to Reader Service Card, Circle No. 474

drive gears in BOLENS TRACTORS

toughness of MUELLER BRASS

"600" series bronze alloys

Forged bronze gears made from tough, long-wearing Mueller Brass Co. "600" bearing alloy are proving their ability to withstand punishment in the popular outdoor power equipment manufactured by the Bolens Products Division of Food Machinery and Chemical Corporation, Port Washington, Wisconsin. The Junior and Super Mustang rotary tillers, all employ "600" main drive gears to dependably transmit engine power to drive assemblies. The going is rough for equipment of this type in cultivating or tilling heavy soil—but Bolens has a record for ruggedness and, on these and many other Bolens products as well, Mueller Brass Co. "600" gears help make possible that fine performance.

Mueller Brass Co. "600" bearing bronzes are available as forgings, or in rod form. They provide unusually high tensile strength, a dense structure, good resistance to corrosion, and excellent bearing properties. Because of their good machining qualities, the "600" series bronzes can be finished readily—usually at substantial savings in COST.

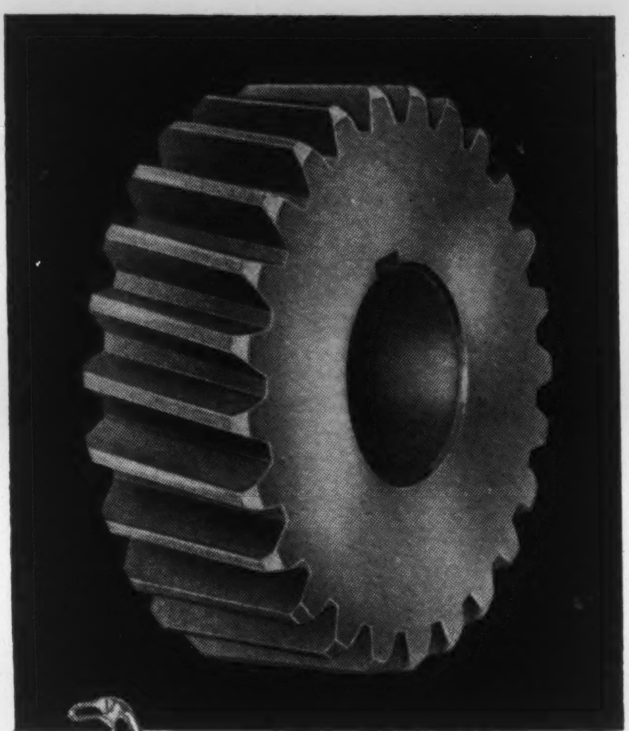
It will pay you to investigate these alloys for your products . . . why not write today for full information.

Ridemaster

Bolens' Ridemaster riding model garden tractor incorporating an 8⅝" diameter "600" bronze gear.

and TILLERS prove

CO.



Bolens' Super Mustang rotary tiller incorporating a 25-tooth "600" series bronze worm gear.

• WRITE TODAY FOR THE ENGINEERING MANUAL YOU NEED

Mueller Brass Co. Forgings Engineering Manual H-58565 ☐

Tuf Stuf Aluminum Bronze Alloys Engineering Manual H-58563 ☐

"600" Series Bearing Alloys Engineering Manual FM-3000 ☐

Copper Base Alloys in Rod Form Engineering Manual FM-3010 ☐

forgings
• brass
• bronze
• aluminum

METALS AND ALLOYS REVIEW

by FRANK M. LEVY

Vice-President and Director of Research

One of the most interesting things about our 600 series bearing alloys is the great variety of products in which they find application. In the advertisement to the left you can see how the Bolens people put 600 gears to work in their rotary tillers and garden tractors. Those gears are big, take a lot of abuse, and meet the job needs perfectly. We also make a lot of small parts, too, that have been specified because of the many unusual properties of this series of alloys.

One good example that comes to mind is a shaft bushing on a rotary selector switch that we make for an instrument manufacturer. This selector is used for switching sound-powered telephone circuits aboard Naval vessels. One of the most important considerations in the choice of 600 alloy for this bushing was its resistance to abrasive action on and against a rubber "O" ring. The acceptance test required a stainless steel shaft riding in the bushing to rotate "dry" for a minimum of 50,000 cycles consisting of 360° rotation clockwise followed by a 360° rotation counter-clockwise. The "O" ring must still form a watertight seal at the end of the test. Our 602 alloy was the only one of several materials tested that met the specs. That was pretty good evidence in itself of resistance to abrasion, but, in addition, this customer also found that the use of 602 eliminated the headaches they previously had with seizing and galling.

The pounding action caused by the indexing mechanism attached to the shaft used to give them no end of seizing troubles. The chief product engineer is extremely happy about the way our alloy is performing. Mention was also made of the fact that the corrosion resistance of 602 was mighty impressive. In this application, the alloy passed the 200-hour Navy salt spray test with flying colors.

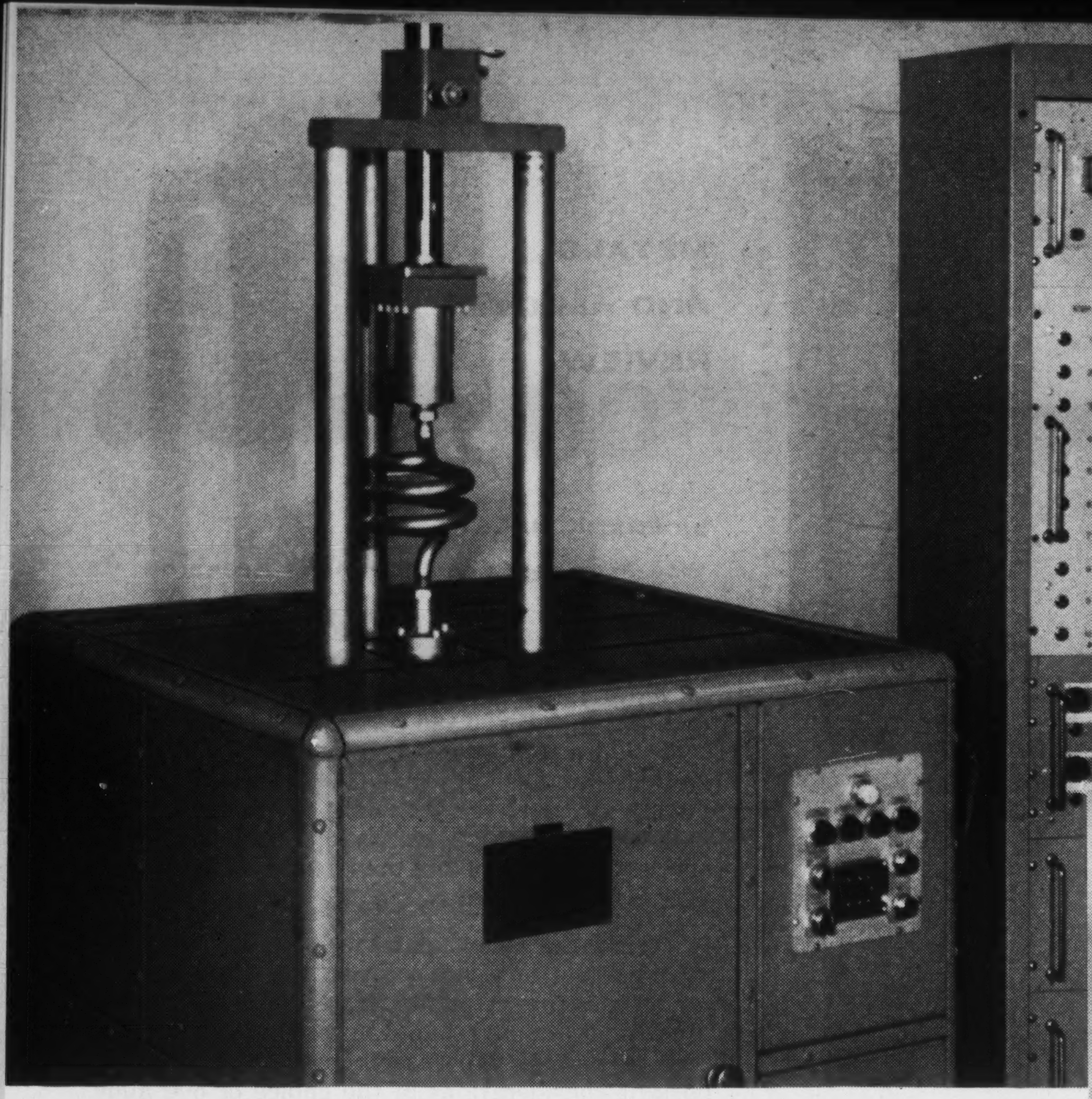
So, big or small, it seems that there is no end of applications for 600 series alloys. We even have parts working in a machine that slices frankfurters as well as gears in fishing reels. So, it seems that 600 runs the gamut from "red hots to reels". Well, it looks like the end of the page is here again, so I'll close for now. However, if you have any problems or questions about non-ferrous alloys or you're having trouble getting desired performance from a part, why not drop me a line here in Port Huron, and possibly I can be of some service. Send a part print along if you like, and we'll be glad to make proper recommendations.

Thanks again for your time.

MUELLER BRASS CO.

PORT HURON 21, MICHIGAN

For more information, turn to Reader Service Card, Circle No. 493



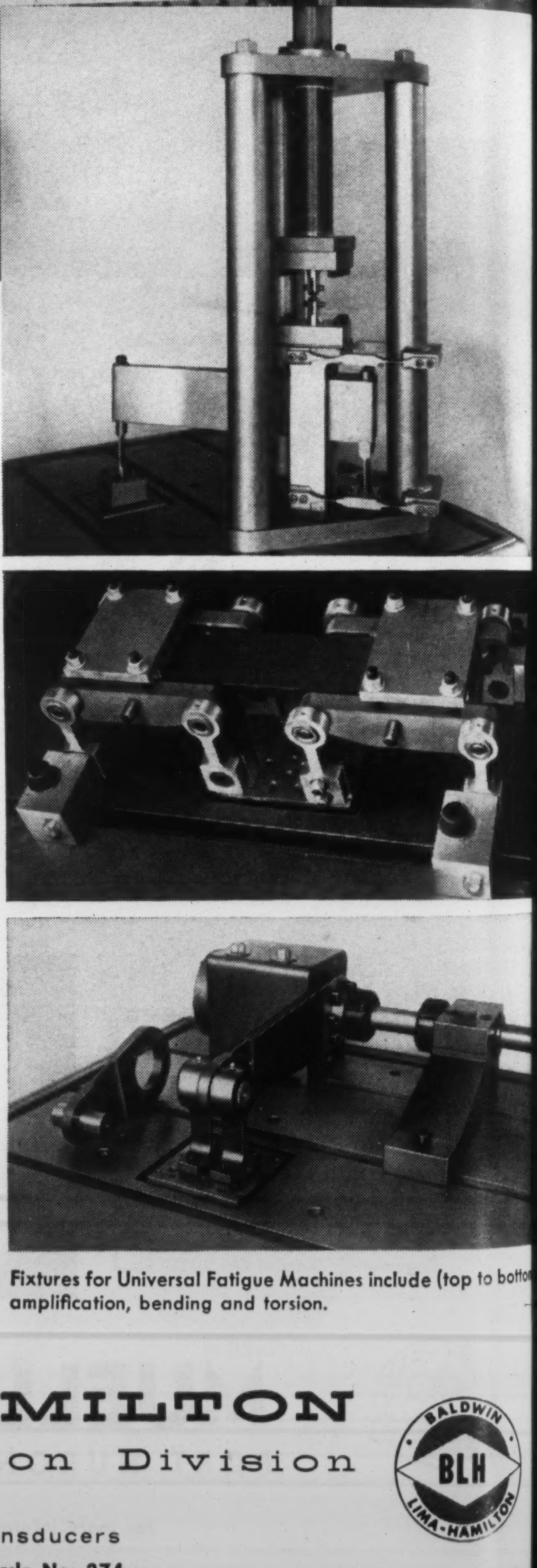
The Baldwin SF-1-U Universal Fatigue Machine shown here is being controlled by the Baldwin Programmer at its side. Entire sequences of varying static or dynamic loads can be run off, all in one automatic operation.

BALDWIN MAKES EVEN SEVERE, PROGRAMMED FATIGUE TESTS AN ACCURATE, AUTOMATIC OPERATION

Here is simulated service testing with flexibility, accuracy and ease never before possible! Baldwin Universal Fatigue Machines have capacities ranging from 50 lb. to 10,000 lb. With proper fixtures, almost any combination of static and dynamic stress may be obtained. Load accuracy is within ±2% of load or 0.4% of capacity, whichever is greater.

Add a Baldwin Programmer to your Baldwin SF-1-U Fatigue Machine, and you have testing automation! Complete test sequences can be set up on the programmer controls and run off on the fatigue machine without supervision. Varying static or dynamic loads, for any predetermined number of cycles are possible. Loads can be changed at approximately 500 lb. per min.

For the best in testing, see Baldwin first . . . choose from a complete line of equipment for testing compression, tension, creep, fatigue, impact or torsion. Write today and ask to have a Baldwin representative call on you.



Fixtures for Universal Fatigue Machines include (top to botto
amplification, bending and torsion.

BALDWIN · LIMA · HAMILTON
Electronics & Instrumentation Division
Waltham, Mass.

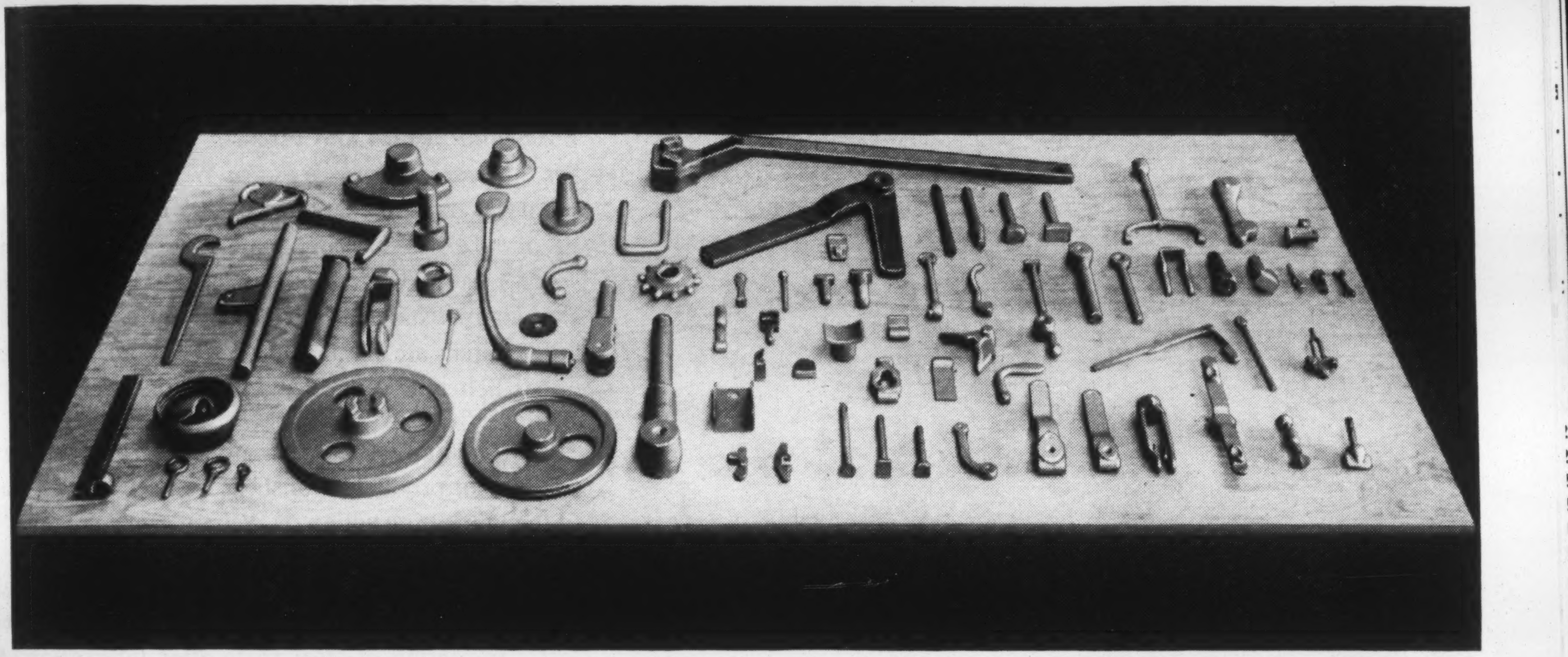
Testing machines • SR-4® strain gages • Transducers

For more information, turn to Reader Service Card, Circle No. 374

200 Different Parts Heated for Forging-

Better, Faster and at Much Lower Cost

with TOCCO* *Induction Heating*



• When progressive production people at General Railway Signal Company installed a 200 kw, 3000 cycle TOCCO machine, they were able to eliminate 7 slot-type oil-fired furnaces and produce better forgings than ever before—at substantially lower costs.

Cost Down—Fuel costs have been reduced from $15.26 to $1.60 per hour with TOCCO. Expensive furnace lining maintenance has been eliminated, and straightening and reheating operations formerly required are no longer necessary.

With oil-fired furnaces all steam hammer operators needed helpers. With TOCCO most of these helper operations have been eliminated.

TOCCO's fast, automatic operation produces almost no scale and achieves uniform temperatures throughout the entire cross section—improving the quality of the forgings and providing increases of up to 40% in the life of the forging dies.

Overall production costs in the forge shop at G.R.S. have been reduced an impressive 35%!

Flexibility—Production runs at G.R.S. range from a low of 15 pieces to a high of over 50,000. Parts from ½ pound to over 25 pounds are heated, merely by changing inductor coils and power control settings.

Better Working Conditions—TOCCO makes the forge shop a better place to work by doing away with noise, dust, dirt, smoke and radiant heat and gases produced by old fashioned furnaces.

If you're looking for a way to produce similar results in your plant, it will pay you to consult a TOCCO Engineer.

TOCCO

JUST PUSH A BUTTON

THE OHIO CRANKSHAFT COMPANY

***Mail Coupon Today*—NEW FREE Bulletin**

The Ohio Crankshaft Co. • Dept: T-6, Cleveland 5, Ohio

Please send copy of "Typical Results of TOCCO Induction Heating for Forming and Forging".

Name____

Position______________________________________

Company_____________________________________

Address______________________________________

City______________________**Zone**______**State**_________

For more information, turn to Reader Service Card, Circle No. 472

BEHIND THE GLAMOR, WEIRZIN® RUST PREVENTION

Production *and* product bonuses are all yours with Weirzin electrolytically zinc-coated steel, as many a manufacturer is finding out.

Take Farrington Manufacturing Co., Needham Heights, Mass., for instance—makers of jewel cases, display boxes and metal radio cabinets. "We make the shells for our cases and boxes out of Weirzin," a spokesman reports. "Its zinc coating prolongs the life and beauty of our Texol® covering materials because it retards rust formation which would cause surface irregularities. Interior rust stains in our delicate satin and velvet lining materials are eliminated. Furthermore, our adhesive bonds better to Weirzin than to plain steel.

"In the matter of die life, we have substantially increased our production of shells between grinds, thanks to the lubricating action of Weirzin's zinc coating."

Weirzin's zinc coating stands up under the most punishing fabrication steps, too. Won't chip, flake, peel; ends costly re-coating of steel parts after fabrication. And *chemically treated* Weirzin takes paints, enamels, lacquers and lithograph inks beautifully; holds them better than any other form of steel; eliminates underfilm corrosion. Investigate Weirzin's superior steel fabricating qualities and flawless rust prevention.

Write Weirton Steel Company, Dept. E-12, Weirton, West Virginia, for free illustrated booklet—"Weirzin."

WEIRTON STEEL COMPANY

WEIRTON STEEL COMPANY

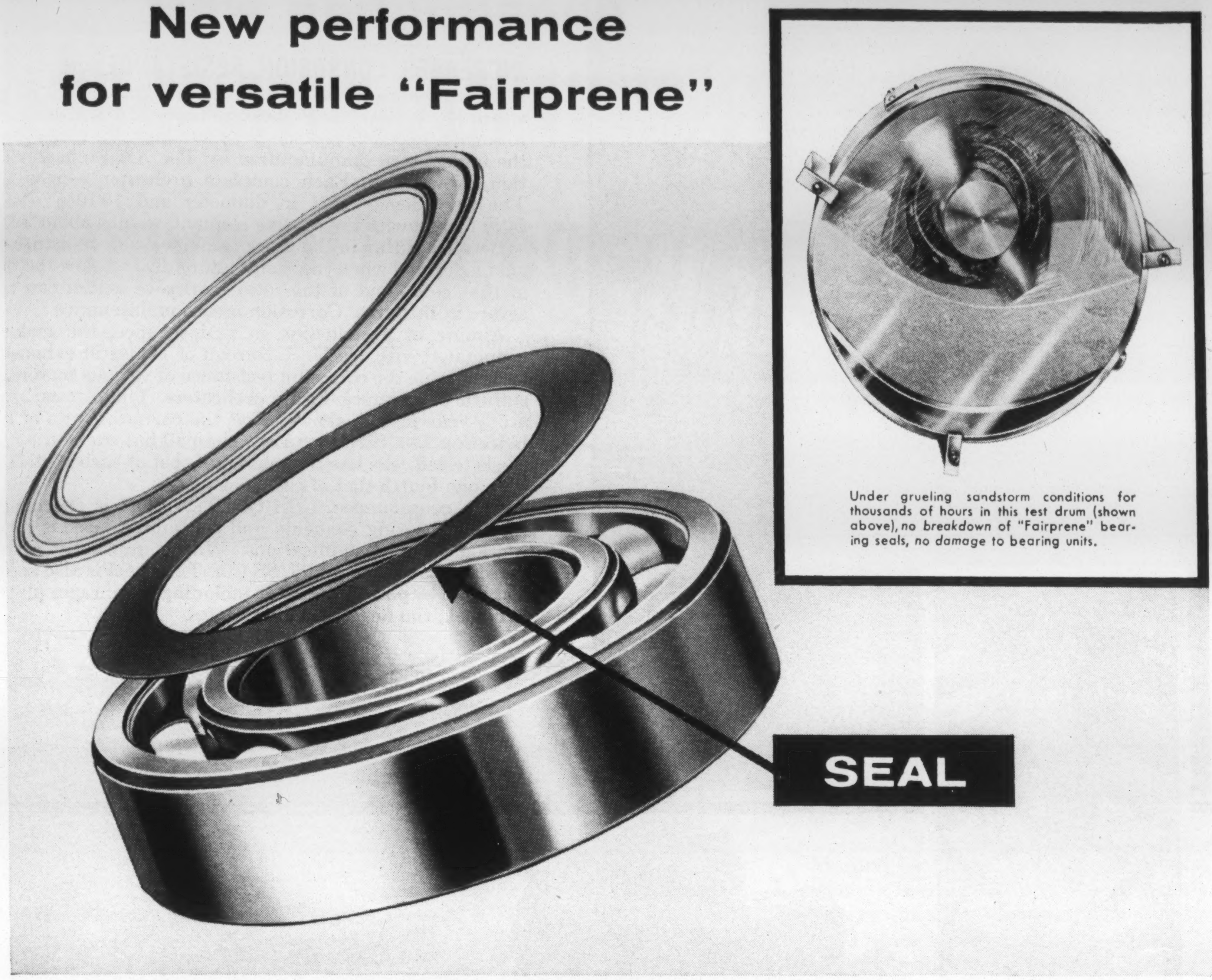
WEIRTON, WEST VIRGINIA

a division of

NATIONAL STEEL CORPORATION

For more information, Circle No. 422

New performance for versatile "Fairprene"



Under grueling sandstorm conditions for thousands of hours in this test drum (shown above), no *breakdown* of "Fairprene" bearing seals, no *damage* to bearing units.

Long-lasting bearing seal of Du Pont FAIRPRENE® unaffected by grease, heat, aging or moisture

DU PONT INDUSTRIAL COATED FABRICS

COATING MEDIUMS

Neoprene • Buna-N • Silicone • Polyacrylate
Chlorosulfonated Polyethylene • Tetrafluoroethylene
Butyl • Acrylic • Polyamide
Polyethylene • Polysulfide

SUBSTRATES

Fabrics	Felts or Non-Woven
Cotton . Nylon . "Dacron"*	"Teflon" Felts
"Orlon"** . Asbestos . Glass	Wool Felts
Metal . Rayon . "Teflon"***	

Also elastomer sheet stocks without fabric inserts and cements

*"Dacron" is Du Pont's registered trademark for its polyester fiber
**"Orlon" is Du Pont's registered trademark for its acrylic fiber
***"Teflon" is Du Pont's trademark for its tetrafluoroethylene fiber

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

SKF Industries, Inc., chose a Du Pont "Fairprene"† coated fabric for bearing seals that lock grit out, grease in—give maximum protection for the life of the bearing unit with no breakdown due to lubricants, heat, moisture or aging.

This is a typical example of the superior performance you can expect from "Fairprene" coated fabrics made to close dimensional tolerances for a wide range of applications. Do you need a material resistant to gas, oils, solvents or corrosive chemicals? To abrasion and flex cracking? To temperatures from −100°F. to 500°F.? Or does your design call for superior insulation or anti-stick properties? Get all the facts about versatile Du Pont industrial coated fabrics. Simply fill out and mail the coupon.

†*"Fairprene" is Du Pont's registered trademark for its coated fabrics, sheet stocks and cements.*

E. I. du Pont de Nemours & Co. (Inc.), Dept. MM-76,
Fabrics Division, Wilmington 98, Delaware

Please send me further information about coated fabrics.

I am interested in using a coated fabric for________________

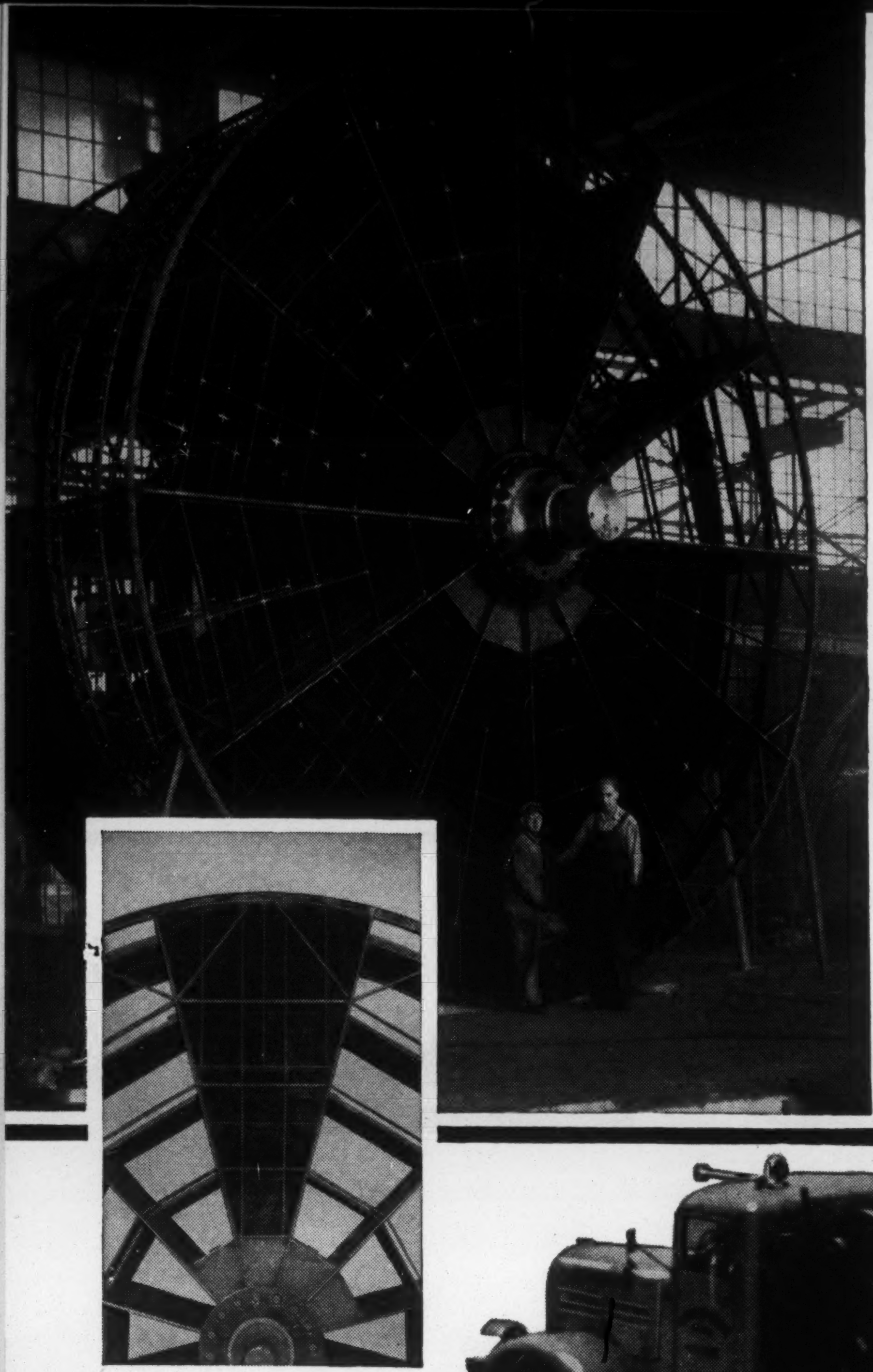
Name________________ **Title**________

Firm________________

Address________________

City________________ **State**________

For more information, turn to Reader Service Card, Circle No. 487



INCREASES CORROSION RESISTANCE.

The huge rotor illustrated here is the main structural component of a Ljungstrom Horizontal Air Preheater. Three of these units, designed to serve a 1,900,000 pounds-per-hour-capacity boiler, are among the largest ever manufactured by The Air Preheater Corporation, New York. Each complete preheater weighs 270 tons. The rotor itself—25′2″ in diameter and 10′10½″ deep—when fully loaded with the heating element, weighs about 390,000 lbs.

Because sulfur in the gases combines with moisture—sulfuric acid is formed when the temperature drops below the dew point at the "cold" end of the rotor—corrosive action can be highly severe in this area. Corrosion means maintenance.

Aiming at a reduction in maintenance, the manufacturer cooperated with the U. S. Bureau of Mines in exhaustive tests to determine the corrosion resistance of various materials under sulfuric acid attack in air preheaters. These tests, made over a 5½-year period, showed that the corrosion rate of low-alloy USS COR-TEN Steel was *lower* than all but one of the *high* alloy steels tested, was less than one-half that of carbon steel and less than one-fourth that of cast iron.

As a consequence, USS COR-TEN Steel is specified for the cold end heating elements and containing baskets on all conventional boiler applications. Where unusually severe corrosion is anticipated, USS COR-TEN Steel is also specified in all or part of the rotor including diaphragm plates, bar stock, rim angle and filler plates.

ARROW TRANSFER CO. LTD

INCREASES DURABILITY, REDUCES COST.

Tote boxes have to take quite a beating. Used for handling, storing and shipping automotive and other parts, they must be able to withstand plenty of rough treatment.

That's why the "Hamlintainer" shown here—a *collapsible* tote box that sets up and folds flat in less than 20 seconds—is now built entirely of USS COR-TEN Steel. COR-TEN Steel's greater strength, 50% higher than carbon steel, makes it possible to build the "Hamlintainer" up to 100 lbs. lighter than carbon steel units, yet so strong and rigid that it will withstand long and rugged service and is not susceptible to bending and distortion. The fact that the COR-TEN Steel ends and sides have the stamina needed to permanently maintain their shape is of utmost importance. It means that throughout its long life the box will always be easy to set up, fold and stack flat.

As compared to the metal construction used in an earlier design, USS COR-TEN Steel makes the "Hamlintainer" not only stronger, more rigid and more durable but also less costly to produce, according to the manufacturer, Hamlin Metal Products Co., Akron, Ohio.

UNITED STATES STEEL
USS
HIGH STRENGTH STEELS
1933 1957
24 YEARS OF PERFORMANCE

High-strength USS COR-TEN Steel pays off in equipment like this

What does your product need to make it better? Greater durability? Bigger capacity? Cheaper maintenance? Lower operating cost?

Do you want to make it stronger, lighter in weight, more corrosion resistant, better able to withstand abrasion, impact and fatigue?

You can obtain any or all of these important money-saving benefits—at little or no increase in cost—by the proper use of high-strength low-alloy USS Cor-Ten Steel.

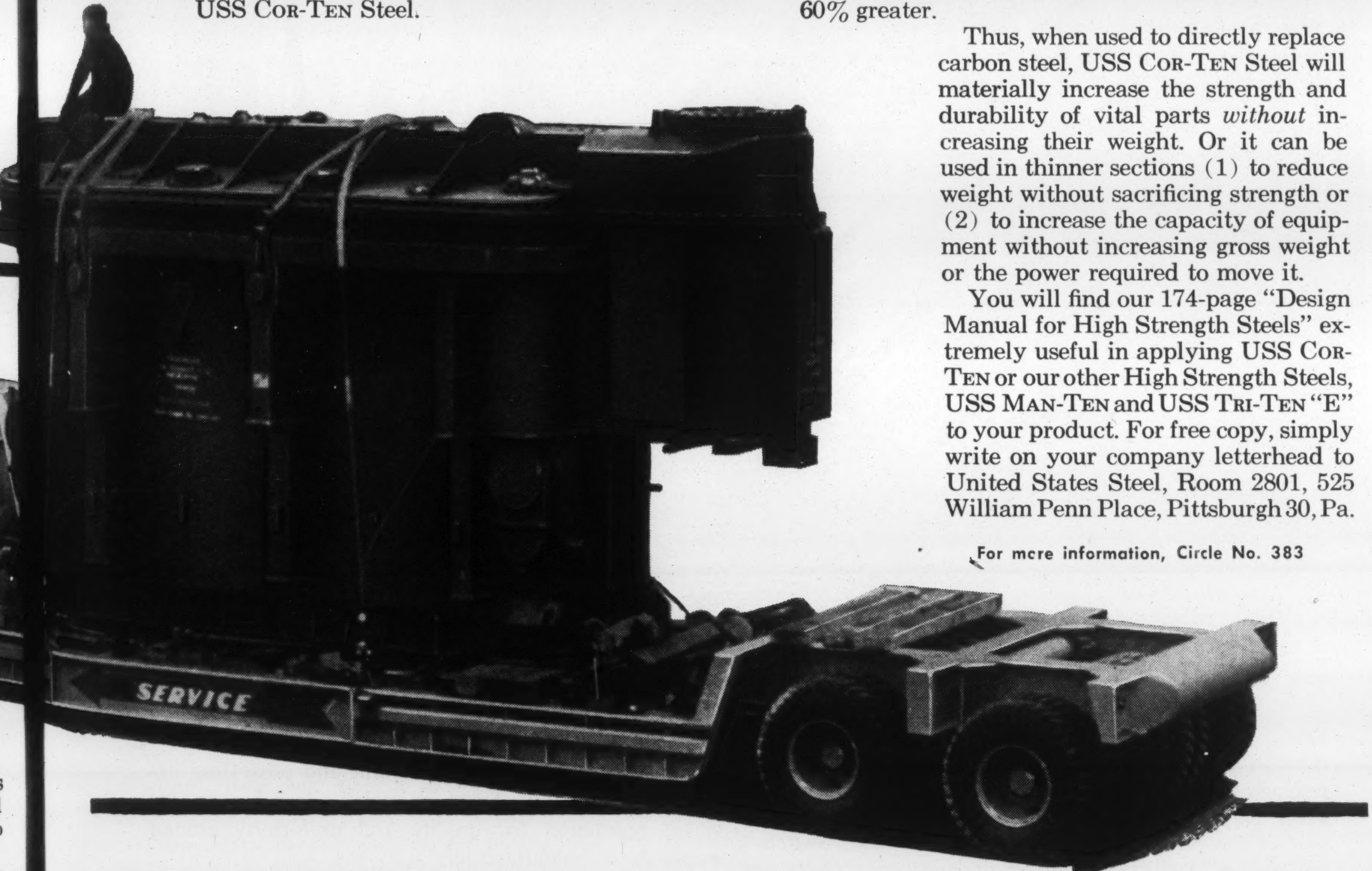
USS Cor-Ten Steel is distinguished by its superior resistance to atmospheric corrosion—4 to 6 times that of carbon steel, 2 to 3 times that of copper steel.

In thickness of ½″ and under, Cor-Ten Steel has a minimum yield point of 50,000 psi and a minimum tensile strength of 70,000 psi. In resistance to abrasion, shock and impact, it is superior to structural carbon steel. Its fatigue resistance is 60% greater.

Thus, when used to directly replace carbon steel, USS Cor-Ten Steel will materially increase the strength and durability of vital parts *without* increasing their weight. Or it can be used in thinner sections (1) to reduce weight without sacrificing strength or (2) to increase the capacity of equipment without increasing gross weight or the power required to move it.

You will find our 174-page "Design Manual for High Strength Steels" extremely useful in applying USS Cor-Ten or our other High Strength Steels, USS Man-Ten and USS Tri-Ten "E" to your product. For free copy, simply write on your company letterhead to United States Steel, Room 2801, 525 William Penn Place, Pittsburgh 30, Pa.

For more information, Circle No. 383



INCREASES STRENGTH, SAVES WEIGHT. Shown here hauling a 117-ton transformer, this 150-ton-capacity trailer—built by Columbia Trailer Company, Vancouver, B. C., for the Arrow Transfer Company of that city—is the largest trailer ever built in Canada.

This 80-ft.-long trailer is constructed almost entirely of USS Cor-Ten Steel. It is about 25% lighter than if it had been built of structural carbon steel. Specifically designed for handling transformers of giant size, it has a depressed center deck which makes loading and unloading easier and keeps center of gravity low to prevent danger of upset.

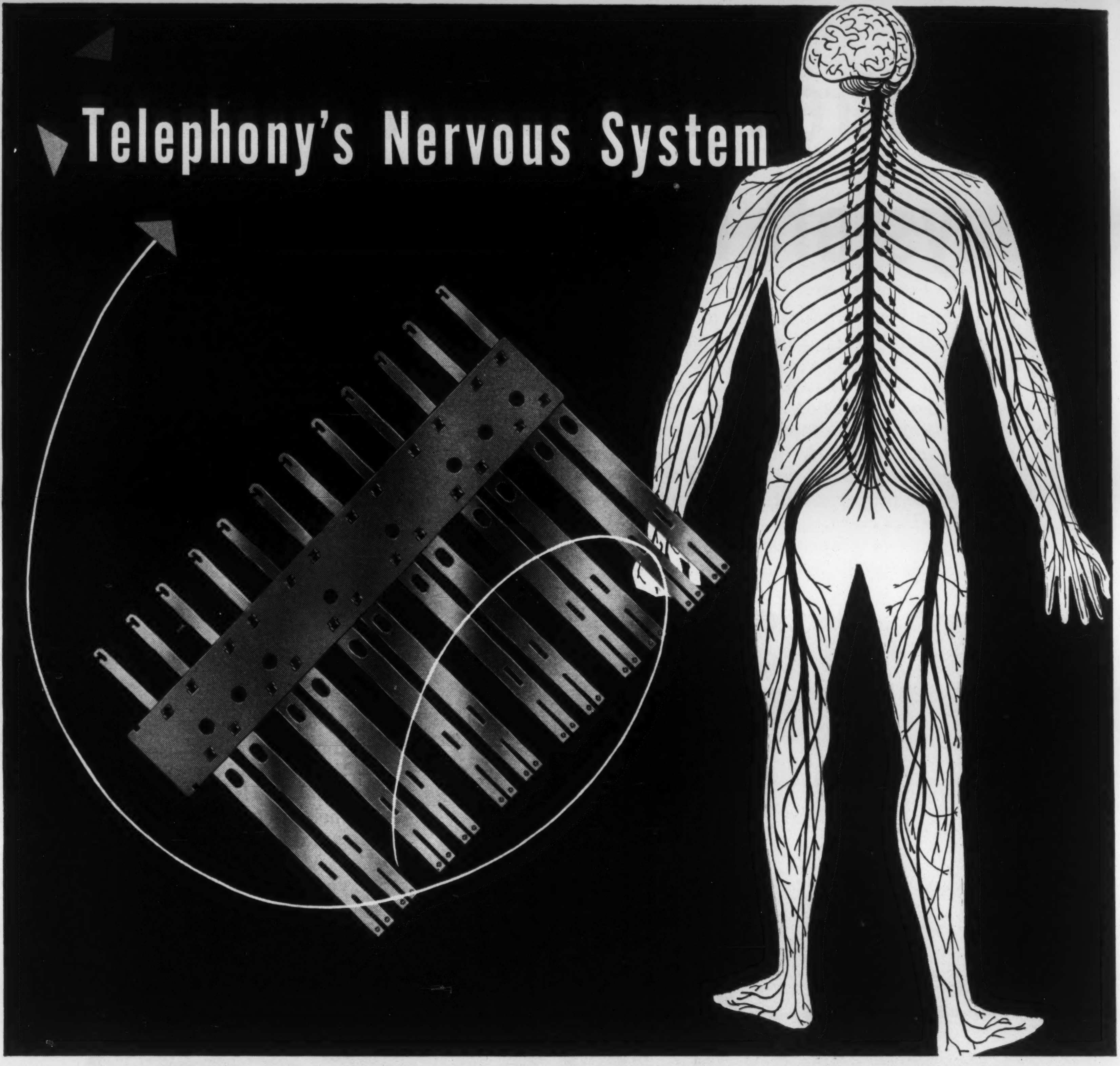
Says the manufacturer: "We have found that when a trailer is made from structural carbon steel there is a greater possibility that it can be permanently damaged from overloading than in the case of a similar unit made from high strength steels. That's why, in designing trailers of this type, we always use USS Cor-Ten Steel. This construction gives us the high strength needed, plus excellent corrosion resistance and freedom from excess weight—all very important in equipment like this."

UNITED STATES STEEL CORPORATION, PITTSBURGH • AMERICAN STEEL & WIRE DIVISION, CLEVELAND • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
NATIONAL TUBE DIVISION, PITTSBURGH • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS HIGH STRENGTH STEELS

USS MAN-TEN • USS COR-TEN • USS TRI-TEN

UNITED STATES STEEL



. . . relies on "neurons" of Seymour Nickel Silver

Dial telephones carry your voice to the ends of the earth through an intricate electrical network which closely resembles the human nervous system. Seymour nickel silver plays a key role in modern communications as part of the North Electric Company "Crossbar Switching System" which automates independent telephone company exchanges.

Tiny, neuron-like contacts on North Crossbar switch assemblies rely on flat springs of even-tempered Seymour nickel silver for *trillions* of "makes-and-breaks".

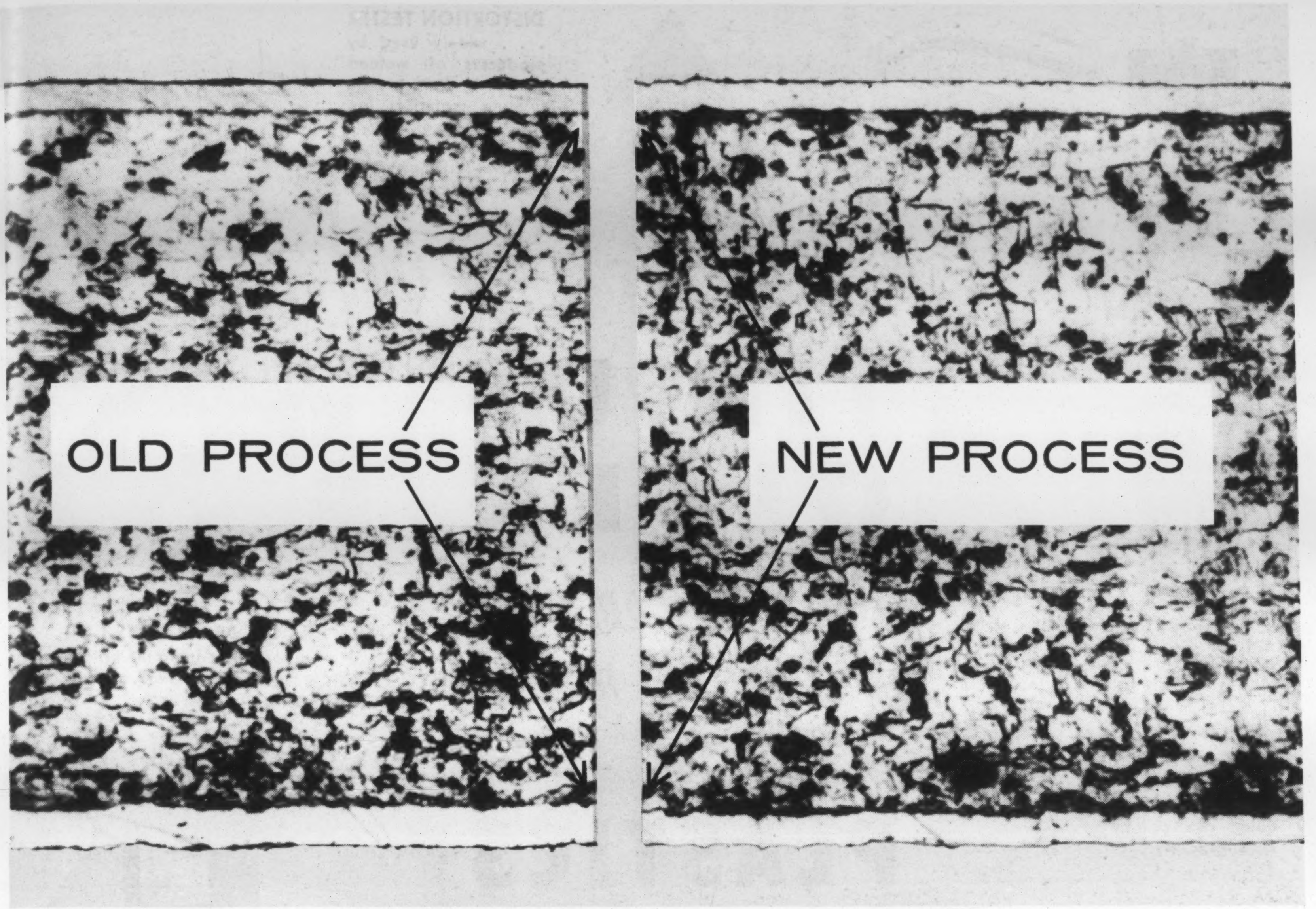
Easy to work, corrosion-resistant and possessing excellent conductivity, Seymour nickel silver has an enviable reputation for quality and uniformity among hundreds of manufacturers who say: —
"Specify SEYMOUR. You KNOW it's good!"

Perhaps Seymour metallurgists can help solve your materials problems. Tell us your requirements.

Long distance telephone operators link distant points to the North Crossbar System in Seymour, Indiana.

THE SEYMOUR MANUFACTURING COMPANY
9 FRANKLIN STREET, SEYMOUR, CONNECTICUT

For more information, turn to Reader Service Card, Circle No. 426



Photomicrographs of plated strip demonstrate the greater degree of side-to-side uniformity made possible by Sylvania's new strip plating process (right). Compare it to similar strip plated by ordinary processes (left).

New process improves side-to-side uniformity of plated metal strip

Sylvania's new strip plating process is adaptable to a wide range of base metals and plating materials and is capable of plating thicknesses up to .005″, on base metals up to .030″ thick and 8″ wide. The close plating control inherent in this process makes it adaptable to controlled distribution from side to side as well as equal side-to-side plating.

Strip, plated by this process, can be used in place of more costly clad strip. In addition, high uniformity plated strip can eliminate the need for plating formed parts to be used where good electrical contact and a high degree of solderability are required. Forming these parts from plated strip can reduce costs when there is good utilization of the plated strip, and can facilitate new automated production techniques.

A new technical bulletin entitled "Sylvania Plated Metal Strip" is available upon request.

Plated Strip is another product of Sylvania's 4-way service to designers. Depending on your needs it can be produced in base metals such as steel, brass, and bronze—plated with nickel, silver and copper.

Sylvania's Parts Division also offers complete service in alloy, clad, and plated fine wires, wire welds, custom molded plastics, metal stampings, and electronic components. Write for complete details.

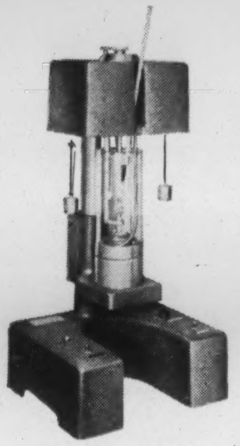
SYLVANIA PARTS DIVISION

Sylvania Electric Products Inc., Parts Division, Warren, Pennsylvania

LIGHTING • RADIO • TELEVISION • ELECTRONICS • ATOMIC ENERGY

SPECIAL WIRE
METAL STAMPINGS
MOLDED PLASTIC
ELECTRONIC COMPONENTS
4-way service from one source

For more information, turn to Reader Service Card, Circle No. 539



TORSION STIFFNESS
. . . for determining rate of extrusion of thermoplastics under prescribed conditions of temperature and pressure.

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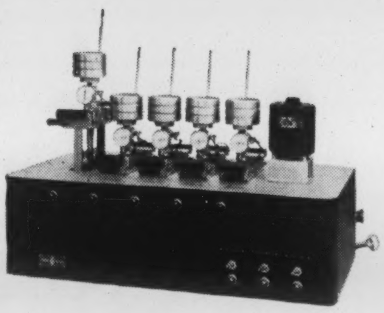
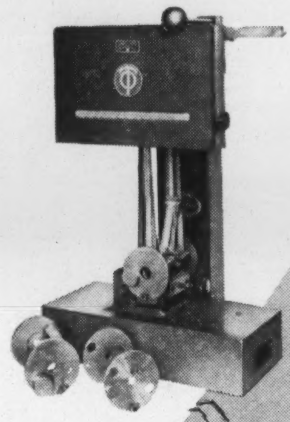
DISTORTION TESTER
. . . widely used by producers of molded plastics and electric insulating materials for indicating heat distortion temperature. Model shown tests five specimens simultaneously.





IMPACT TESTER
. . . patented "Change O-Matic" striking head for quick reading Charpy or Izod tests.

TINIUS OLSEN

the most complete line of testing machines for

PLASTICS

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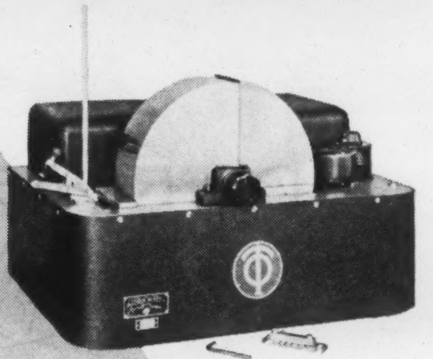
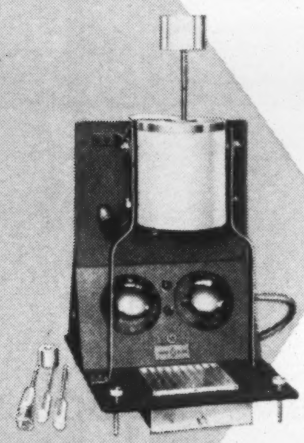
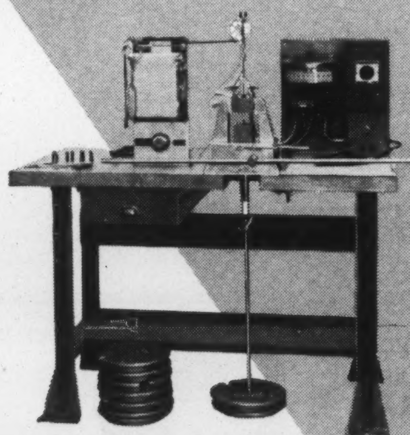


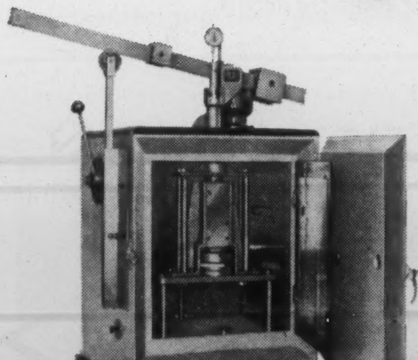
BRITTLENESS TESTER
. . . used for determining the brittleness of plastic specimens at subnormal temperatures.

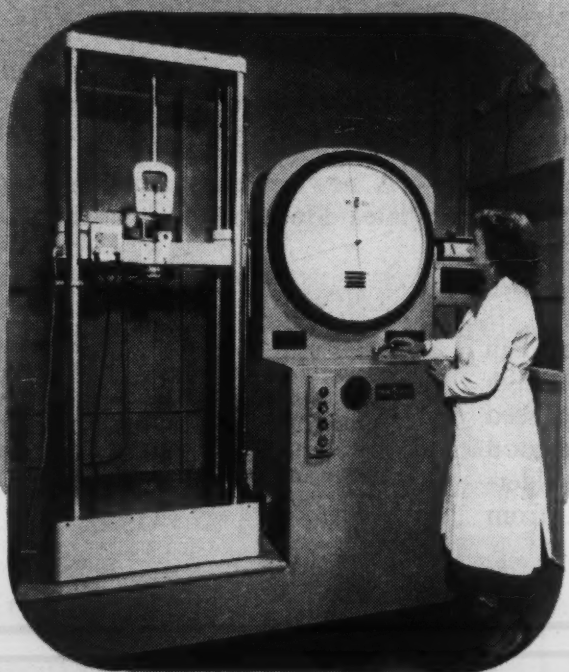


EXTRUSION PLASTOMETER
(Melt Indexer)
. . . ideal for measuring the flow rates of thermoplastics.



FLOW TESTERS
. . . Olsen Bakelite and Parallel Plate Plastometer models available. Curves can be conveniently charted on the flow characteristics of both thermoplastic and thermo-setting materials.





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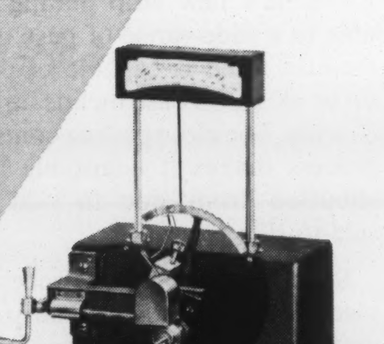

STIFFNESS TESTERS
. . . in 1, 6 and 50 inch-pound capacities. For testing sample strips or completed products—detects small variations in elasticity, brittleness, toughness and plastics flow.

CREEP TESTER (not shown)
. . . 6 unit creep tester designed for plastics.

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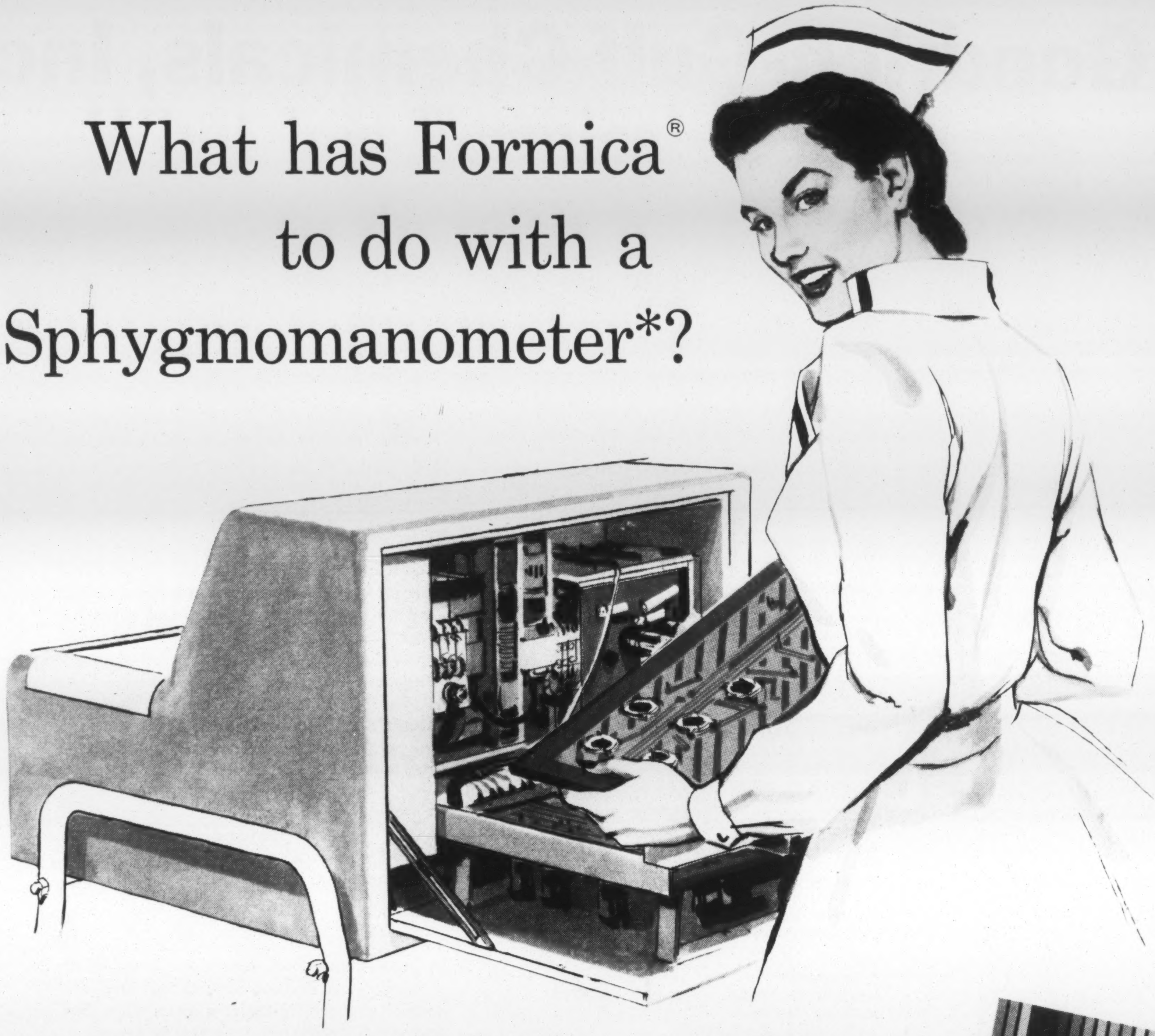

This sphygmomanometer* – or automatic blood pressure recorder, if you prefer – demonstrates how Formica XXXP-36 copper clad laminated plastics is being used in a versatile printed circuit application.

In this case, a printed circuit provides the absolute interchangeability of parts in the field which simplifies and reduces the cost of field service on complicated electronic products.

The application versatility of Formica XXXP-36 then can be applied to many different kinds of electrical and electronic applications. You'll benefit especially from Formica-4 – the complete laminated plastics service that cuts engineering time, reduces component parts costs and assures delivery schedules for mass production operation.

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Goodrich-Gulf Chemicals, Inc.

Ameripol...

HOT POLYMERS

Types	*Physical Properties**		*Selection Guide*
1000	Tensile Elongation Modulus @ 300% Elongation Mooney Viscosity— ML212°F. @ 4 minutes Raw Polymer Compounded Stock	3030 psi. 600 % 980 psi. 48 55	General purpose rubber for products where color unimportant. Used for tires, molded and extruded products.
1001	Tensile Elongation Modulus @ 300% Elongation Mooney Viscosity— ML212°F. @ 4 minutes Raw Polymer Compounded Stock	3030 psi. 600 % 1010 psi. 47 55	Similar to 1000, but less staining and discoloring. For tires, shoe soles and heels, molded and extruded products.
1002	Tensile Elongation Modulus @ 300% Elongation Mooney Viscosity— ML212°F. @ 4 minutes Raw Polymer Compounded Stock	3000 psi. 650 % 950 psi. 53 55	Rosin acid soap provides more processing tack and lower modulus than 1000 and 1001. For tires, molded and extruded products.
1006	Tensile Elongation Modulus @ 300% Elongation Mooney Viscosity— ML212°F. @ 4 minutes Raw Polymer Compounded Stock	2850 psi. 590 % 1010 psi. 50 58	An improved, lighter colored rubber, relatively non-discoloring and non-staining. For white and pastel colored products—tile, toys, side walls, etc.
1007	Tensile Elongation Modulus @ 300% Elongation Mooney Viscosity— ML212° @ 4 minutes Raw Polymer Compounded Stock	2760 psi. 620 % 890 psi. 48 54	Relatively low water absorption, improved electrical properties. For insulation and electrical products, gaskets, etc.
1009	Tensile Elongation Modulus @ 300% Elongation Mooney Viscosity— ML212°F. @ 4 minutes Compounded Stock	1850 psi. 360 % 770 psi. 126	A cross-linked polymer used with other polymers to reduce shrinkage and die swell in calendering and extrusion. For footwear, insulation, calendered goods.

***Typical average, production values. Cure 50' at 292°F.**

Hot polymer man-made rubber easily processed... furnished in bale or crumb form

Ameripol is the preferred butadiene-styrene rubber . . . superior or equal to natural rubber in aging, resistance to wear, weathering, water, oil, permeability to gases.

The hot polymer grades are most easily processed. Furnished in compressed bale form for molded and extruded products; in crumb form for solubility in adhesives, mastics, cements. Because of low molecular structure, Ameripol hot polymers go into solution easily and quickly.

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MANUFACTURERS' LITERATURE

New Literature

Carbide Powders. Allegheny Ludlum Steel Corp., Carmet Div., 15 pp, illus. A series of data sheets giving typical applications, analysis, physical characteristics and a photomicrograph showing the grain structure of various grades of carbide powders. A series of charts gives transverse rupture, electrical conductivity and resistance to abrasion. (2)

Teflon Insulated Wire. Alpha Wire Corp., 4 pp, No. T-1. Describes engineering characteristics of Teflon insulated wire for high frequency, high temperature, miniaturizing and weatherizing applications. Gives conductor sizes and strands, insulation thickness, voltage rating, outside diameter and stock colors. (3)

Plastics Products. American Agile Corp., 4 pp, illus. Outlines properties and uses of a line of molded, cemented, and welded plastics valves, acid tanks, fans, laboratory ware, sheets, blocks, rods, pipe and fittings, and tubing and ducting. Information also on how to weld and spray plastics. (4)

Steel Forgings. American Brake Shoe Co., 16 pp, illus. Data on the various uses of steel forgings. Also depicts research, engineering and production facilities for drop, press and upset forgings. (5)

Metal Finishes. American Chemical Paint Co., 8 pp. Guide to the chemical treatment of such ferrous and nonferrous metals as steel, iron, zinc, cadmium, and aluminum. Lists metal products treated, object of coating, type of coating, method of application, and coating time and weight. Outlines phosphatizing, rust proofing and paint bonding chemicals for the government and its contractors. (6)

Copper. American Metal Co., Ltd., 8 pp, illus., No. C-13. Chemical analysis, advantages and physical properties of an oxygen-excluded copper for electronic applications. Briefly describes such advantages of the material as immunity to embrittlement, high conductivity and low volatility under high vacuum. (7)

Zinc Anodes. American Zinc Institute, Inc. Two reference manuals describing the use and application of zinc as a galvanic anode to protect iron and steel from corrosion. *Zinc as a Galvanic Anode Underwater* is a 16-page booklet describing the way zinc anodes protect marine craft, water storage tanks, pilings in sea water, and spillway and lock gates against corrosion. *Zinc as a Galvanic Anode Underground* is a 40-page illustrated book that discusses the theory and practice of zinc anode application in transmission pipe lines, gas distribution systems and transmission line towers. (8)

Metals for Semiconductors. Anchor Metal Co., Inc., 4 pp, No. 56A-2. Periodic chart of the elements and a chart outlining physical properties of pure elements used in semiconductor production. Lists metals and alloys used in semiconductors and gives equilibrium phase diagrams for ten of the more popular "doped" alloys. (9)

Steel Tubing. Armco Steel Corp., 4 pp, illus. How to cut costs, get faster production and improve design with welded steel tubing. Also describes how finishing operations can be eliminated with the company's line of Zincgrip and Aluminized steel tubing. (10)

Rubberized Hair. Armour & Co., Curled Hair Div., 4 pp, illus. Price list for soft, medium, medium-firm and firm grades of rubberized curled hair and rubberized curled hair topped with polyurethane foam. (11)

Alloy Steel Tubing. Babcock & Wilcox Co., Tubular Products Div., 4 pp, No.

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TDC-184. Gives size range, types and quality of tubing made from 12 of the most widely used 4100 series alloy steels. Condensed data are given on carburizing and thermal treatments, mechanical properties, and welding and machining of these steels. (12)

Epoxy Adhesive. Carl H. Biggs Co., Inc. 4 pp. Information on a one-component epoxy adhesive that is used to bond metals to each other and to other materials. Gives physical and chemical properties. Briefly outlines surface preparation of metal and application methods. (13)

Beryllium Copper Parts. H. Braun Tool & Instrument Co., Inc. 12 pp, illus., No. 573. Gives physical and electrical characteristics, chemical composition, formability and stress data on a beryllium copper alloy. Gives dimensional tolerances on standard beryllium copper grounding and contact strips. (14)

Ultrasonic Cleaning. Buehler Ltd., 8 pp, illus. Current issue of *Metal Digest*, Vol. 3, discusses the advantages of using ultrasonic cleaning for metallographic samples. Shows a generalized circuitry used in a laboratory type cleaner. (15)

Fasteners. Camloc Fastener Corp., 52 pp, illus., No. 55. Catalog of quarter-turn and other types of fasteners for use in aircraft, electronic and industrial products. Gives dimensional and installation data for studs, grommets, latches, receptacles and tools. Contains stud selection and weight tables. (16)

Zirconium. Carborundum Co., Metals Div., 8 pp, illus. Current issue of *More Zr Facts*, Vol. 1, discusses the corrosion resistant properties of zirconium. Includes advantages of zirconium's use in various types of atomic reactors and in chemical processing applications. (17)

Silicon Carbide. Carborundum Co., Refractories Div., 4 pp. illus. Briefly discusses warpage, heat shock resistance, wetability, heat conductivity, weight, hot strength, chemical inertness, machinability and thermal expansion of Refrax silicon carbide for continuous brazing. Physical properties of Refrax shapes are shown in tabular form. (18)

Stainless Steel Tubing. Carpenter Steel Co., Alloy Tube Div., 4 pp, illus. Describes use of 17-7PH stainless steel in tubular form and gives analysis, recommended uses, mechanical properties, corrosion resistance, workability and hardening characteristics. Also covers physical and nondestructive tests that are given the tubing and pipe in manufacture. Charts show the range of sizes available in both forms. (19)

Plastics Parts. Comco Plastics, Inc., Div. of Commercial Plastics & Supply Corp., 8 pp, illus. Two data sheets on the company's line of plastics products. One sheet lists mechanical, electrical and physical properties of various grades of plastics laminates to meet NEMA specifications. The other data sheet outlines mechanical, electrical, thermal, chemical and physical properties of polyethylene, methacrylate, polystyrene, nylon, Teflon and acetate rods, tubes and sheets. (20)

Silicone Rubber. Connecticut Hard Rubber Co., 407 East St., New Haven 9, Conn. Price $1.00. 48 pp, illus. Reprint of three papers on silicone rubber. The first paper discusses the basic chemistry of silicone rubber and the other two papers outline specific properties of different silicone compounds and fabrication techniques used in producing silicone rubber parts. Write directly to Connecticut Hard Rubber Co.

Steel Tubing. Ohio Seamless Tube Div., Copperweld Steel Co., illus. Information on carbon and alloy tubing, aircraft seamless tubing and electrical resistance welded tubing. Lists handbooks that give more complete information on each type of tubing. Contains a standard table of tubing gages for reference purposes. (21)

Teflon Gaskets. Crane Packing Co., 8 pp, illus., No. P-325. Information on 15 types of braided Teflon rings and six types of molded cup and cone rings and combination sets. Gives specific recommendations as to applications and service temperatures. Information also on pressures, dimensions and mechanical requirements. (22)

Stainless Steel Tubing. Crucible Steel Co. of America, Trent Tube Div., 48 pp. illus. Gives tubing classifications and applications; a glossary of tubing terms; and physical, chemical and electrical properties of stainless steel tubing. Gives corrosion data and tubing weights for titanium and stainless steel tubing. (23)

Nylon Products. Danielson Mfg. Co., 4 pp, illus. Discusses extruded nylon shapes such as solid rod, tubing, tape and pipe. Also gives information on molded and rust resistant nylon parts for marine applications. (24)

Urethane Foam. E. I. Du Pont de Nemours & Co., Inc., Elastomer Chemical Dept., 8 pp, illus. Outlines chemical solvent, temperature and flame resistance of rigid and semirigid urethane foams. Discusses use of urethane foams as a thermal insulation, structural reinforcement, vibration dampening and sound absorption material. (25)

Teflon Products. Enflo Corp., 6 pp, illus. Dimensional data on Teflon tape, molded bars, sheets and cylinders, and extruded tubing, rods, beading and spaghetti tubing. Discusses custom molded and machined materials and electromechanical and electronic components. Gives typical properties of molded Teflon. (26)

Porcelain Enamel. Erie Ceramic Arts Co., 20 pp, illus. Briefly discusses the origin and development of porcelain enameling, its advantages and its principal features. Also discusses use of porcelain enameling in meter dials, telephone number plates and instruction plates. Outlines special applications and lists enamel reflectance and color standards. (27)

Stainless Steel. Falstrom Co., 2 pp, illus. Briefly describes company facilities for producing stainless steel pans, heavy duty guards, three-compartment dip tanks, self-supporting instrument panelboards and other industrial products. Briefly discusses design, fabrication and inspection of stainless steel parts. (28)

Plastics Products. Fiberite Corp., 5 pp. Physical, electrical and mechanical properties of a line of reinforced phenolic and melamine molding compounds. (29)

Molded Plastics. General Electric Co., Plastics Dept., 8 pp, illus. Molded plastics comparator lists binder, filler, characteristics and typical applications, and mechanical, electrical, thermal and miscellaneous properties of various reinforced plastics. Also gives properties and applications of Mycalex materials and silicone rubber. (30)

Gasket Materials. General Gasket Inc., 4 pp, illus. Information on color-coded gasket material available in a range of 12 gages. Gives price and dimensional information. (31)

Zinc Die Castings. Gries Reproducer Corp., 9 pp, illus. Lists 67 different types of zinc die cast and thermoplastic molded products manufactured by the company. Describes plastics and zinc die cast gears and pinions, and plastics coil bobbins. Standard zinc alloy die cast stock products are divided into four major types of application: general industrial products, specialized industrial products, consumer hardware and fasteners. (32)

Brass, Aluminum Parts. Hampden Brass & Aluminum Co., 24 pp, illus. Information on the production and fabrication of brass and aluminum castings. Shows foundry operations, inspection and testing. Information also on reinforced plastics products produced by the company. (33)

Heat Treating. C. I. Hayes, Inc., 4 pp, illus. Discusses laboratory and production facilities for solving heat treating problems. Outlines services of the company, such as in-plant service and contract work. (34)

Thermosetting Adhesive. Honeycomb Structures Co., Inc., 4 pp, illus. Gives typical applications and physical properties of Honeyco Bond 371W, a liquid thermosetting adhesive for metal-to-metal bonding and honeycomb sandwich construction. Also discusses a process and necessary equipment for applying extruded films and coatings to metal, wood, fabrics and other sheet materials. (35)

Metal Closures. Hudson Tool & Die Co., Inc., 4 pp, illus. Information on precision drawn cases and covers supplied in aluminum, steel, stainless steel, brass and copper. Briefly describes and illustrates standard square, rectangular and round cases, cover assemblies and custom closures. (36)

Decorative Coatings. Interchemical Corp., Finishes Div., 12 pp, illus. Describes a process by which protective and decorative coatings are applied to wood, metal, composition board, plastics and other materials by offset gra-

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vure printing. Describes how such designs as mahogany, mother of pearl, basket weave and maple are applied to picnic hampers, laundry, receptacles, TV sets and other products. (37)

Cermet. Kanthal Corp., 16 pp, illus. Describes the electrical, chemical and physical characteristics of a new cermet material called Kanthal Super. Designs and specifications for high temperature furnaces are given. (38)

Laminated Metals. General Findings & Supply Co., and Leach & Garner Co., 8 pp, illus. Describes precious and other laminated metals for the electronic, aircraft and automotive industries. Gives dimensional data and forms available for laminated sheets, wire and tubing. Also describes the production and availability of precision parts made of precious and ferrous and nonferrous metals. (39)

Heating Unit. Lepel High Frequency Laboratories, Inc., 1 p, illus. Outlines advantages and operation of a high frequency portable heating unit for bonding stranded wire and localized annealing of spring wire. Shows setup for automatic bonding, stripping and cutting of wire. (40)

Teflon Parts. O. J. Maigne Co., 3 pp. Discusses custom molding of preformed and machine-finished Teflon parts. Describes fabrication of Teflon rods and tubes for small to medium size runs for developmental work. (41)

Pearl Coatings. Mearl Corp., 6 pp. Outlines the use of synthetic pearl pigments for use with nitrocellulose, cellulose acetate and ethylcellulose lacquers; vinyl, alkyd and acrylic resins; and water-compatible mixtures. (42)

Protective Coatings. Metalweld, Inc., Protective Coatings Div., illus. Discusses types of protective linings and coatings; why they are important; and when and how they should be applied. Organic, inorganic, metallic and combination coatings are described and evaluated, as are sheet linings. Sample specification sheets are shown. (43)

Phosphor Bronze. Miller Co., Rolling Mill Div., 4 pp, illus. Briefly describes equipment used in the production of phosphor bronze products. Outlines advantages and properties of phosphor bronze products and briefly discusses services offered by the company. (44)

Adhesives, Coatings. Miracle Adhesive Corp., 1 p. Materials selection chart for reclaimed, synthetic and latex rubber adhesives, coatings and sealers; plastics adhesives, sprays and coatings; and epoxy adhesives, casting compounds and caulkings. (45)

Plastics Materials. Monsanto Chemical Co., Plastics Div., 12 pp, illus. Data on the characteristics and applications of styrene, polyethylene, phenolic, melamine, vinyl, cellulose acetate and cellulose nitrate for molding, fabricating, extruding, bonding, laminating, coating and calendering. Information also on adhesives and coatings. (46)

Plastics Products. Norrich Plastics Corp., 6 pp, illus. Gives physical, chemical, electrical and mechanical properties of two epoxy resins used for bobbins, coils, tubes, shells, balls, component parts and bushings. Includes data on nylon, Teflon and fluorocarbons that are molded, drilled and slotted to specifications. (47)

Plastics Cleaner. Northwest Chemical Co., 1 p. Information on the use of a liquid stripper to remove organic finishes from plastics. Data on equipment, operating temperature and stripping time. (48)

Ceramic Coatings. Norton Co., 10 pp, illus., No. CP11.3. Compares the physical properties of aluminum oxide, zirconium silicate and zirconium oxide coatings with those of stainless steel. Outlines the Roxide process for applying ceramic coatings to a variety of materials. Lists numerous applications for these ceramic coatings, including baffle plates, motor tube housings and duct linings. (49)

Steel Fasteners. Nut-Shell Co., 53 pp, illus. Series of specification sheets giving dimensional data, part number, weight, type of material and finish for self-locking, hex. miniature, dome and right angle steel nuts. (50)

Glass-Reinforced Plastics. Owens-Corning Fiberglas Corp., Textile Products Div., 24 pp, illus., No. PR6.Al. Physical, mechanical, chemical and electrical properties of fiberglass-reinforced alkyd, polyester, melamine, polystyrene and phenolic resins. Discusses types and applications of fiberglass chopped strands, milled fibers, roving, mats, cloths and yarns. Briefly describes eight molding procedures for fabricating fiberglass-reinforced plastics. (51)

Marking Tapes. Printed Cellophane Tape Co., 8 pp, illus. Describes over 500 self-adhesive vinyl plastic pipe markers. Also describes self-adhesive cut-out numbers, letters and safety slogans. (52)

Aircraft Parts. REF Mfg. Corp., 4 pp, illus. Illustrates various metals and plastics parts for the aircraft and electronic industries. Some parts shown are a television studio console, flight simulator cabinet, switchboard cabinet, aircraft cargo hatch, helicopter stabilizer, aircraft dive brake and nose wheel door. (53)

Coated Steel Pipe. Republic Steel Corp., 4 pp, illus. Information on Republic's X-Tru-Coat plastics coated steel pipe and tubing. Describes the problems of pipeline corrosion and shows how the strength of steel and the protection of plastics combine to meet the requirements of severe corrosive applications. (54)

Bearing Metal. Joseph T. Ryerson & Son, Inc., 4 pp, illus., No. 80-5. Describes five different types of Babbitt metals in various hardness ranges. Lists applications for each metal and tells how to pour the metal in order to obtain good bearings. (55)

Adhesives for Plastics. Schwartz Chemical Co., Inc., 4 pp, illus. Gives characteristics and applications of adhesives for bonding acrylics to acrylics, for cementing dissimilar plastics for bonding plastics to nonplastics, for bonding celulose acetate to cellulose acetate, and for bonding vinyls to acrylics. (56)

Nonferrous Castings. Shenango Furnace Co., Centrifugally Cast Products Div., 4 pp, illus., No. 154. Gives comparative specifications, chemical analysis and physical properties for such nonferrous metals as tin bronzes, aluminum bronzes, manganese bronzes, brass, silicon bronzes, special alloys and Monel for use as centrifugal castings. (57)

Silicone-Glass Laminates. Silicone Insulation, Inc., 4 pp, illus. Gives typical industrial applications for silicone-glass laminates such as aircraft generators, molded coil bobbins, transformers, jet aircraft brake motors and telephone switch insulators. Physical and electrical properties are given in tabular form. (58)

Welding Wires. Stoody Co., 4 pp, illus. Gives applications, physical characteristics and welding data for 11 different alloy wires used for semiautomatic welding, hard facing and build-up. Describes the semiautomatic welding process and gives general welding data. (59)

Magnetic Tapes. Thomas & Skinner, Inc., 4 pp, No. DME-4. Descriptive data on silicon-iron magnetic tapes. Gives applications, sizes, weights, tolerances, insulation, fabrication, mechanical and physical properties, magnetic properties, core losses and other data. (60)

Aluminum Coating. Arthur Tickle Engineering Works, Inc., 4 pp, illus. Describes the Alumicoat process for bonding aluminum to steel. Gives a step-by-step description of the process and lists typical applications. Table compares corrosion resistance of aluminum coated samples with that of uncoated samples. (61)

Phosphate Coatings. Turco Products, Inc., 6 pp, illus. Covers a line of phosphating and protective coatings for metals. Gives diagrams to show how phosphating works, application photographs and a discussion of the use of coating materials as bonds for paints and other organic finishes. (62)

Heliarc Welding. Linde Air Products Co., Union Carbide & Carbon Corp., 8 pp, illus. Shows various applications of Heliarc welding in fabricating metal products. Included are photographs showing manual and mechanized welding of heat exchange units, stainless steel exhaust systems, evaporator units, magnesium shell racks, lead flashings and stainless steel exhaust cones for jet engines. (63)

Other Available Literature

Irons & Steels • Parts • Forms

Malleable Iron. Albion Malleable Iron Co., 15 pp, illus. Defines malleable iron and its relationships to other ferrous materials. Micrographs, physical properties and relative cost figures are included. (68)

Leaded Steel. Alco Products, Inc., illus., 8 pp. Facts about leaded steel for seamless forged and rolled rings. Physical property data on 11 grades and section sizes of Alco Hi-Qua-Led steel are included. (69)

Spun Steel Tubing. American Cast Iron Pipe Co., 64 pp, illus. Shows fabrication of spun tubing. Tables, charts and graphs give dimensional data, physical properties and applications. (70)

Steel Making. American Iron & Steel Institute, 8 pp, illus. Elementary explanation of steel making. (71)

Stainless Steel Fasteners. American Screw Co., 7 pp. Gives physical properties and applications of stainless steel fasteners. (72)

Prefinished Metals. Apollo Metal Works, 8 pp, illus. Describes variety of prefinishing work on metals for special design and fabricating problems. (73)

Spring Steels. Wallace Barnes Steel Div., Associated Spring Corp., 48 pp, illus. Characteristics and uses of spring steels are discussed together with information as to types available and their specifications. Physical property charts correlate thickness and tensile strength for three ranges of hardness. (74)

Low Alloy Steel. Bethlehem Steel Co., 66 pp, illus., No. 353. Properties and features of Mayari-R steel for corrosion resistance applications. (75)

Alloy Tubing. Bishop & Co. Platinum Works, Stainless Steel Products Div., 12 pp, illus. Catalog of cold drawn stainless steel tubing — mechanical capillary and hypodermic. (76)

Finned Tube. Wolverine Tube Div., Calumet & Hecla, Inc. Covers applications for Trufin integrally finned tube in the electrical, refrigeration and allied industries. (77)

Ferrous Castings. Campbell, Wyant & Cannon Foundry Co., 24 pp, illus. Describes facilities for producing gray iron and steel castings. (78)

Alloy Comparison Chart. Cannon-Muskegon Co. Comparison chart of AISI, SEA, ACI, AMS, WAD and PWA alloy specifications. (79)

Chromized Steel. Chromalloy Corp., 4 pp, illus., No. 20. Typical applications of case hardened steel produced by the Chromalloy process. (81)

Steel Products. Crucible Steel Co. of America, Engineering Service Dept., Box 1558, Pittsburgh 30, Pa., 232 pp, illus. Indexed catalog of over 700 steel products. Lists 16 categories of special purpose steels. Write directly to Crucible.

Alloy Handbook. Wilbur B. Driver Co., 150 pp, illus. Manual on company's alloys, technical services, plants and facilities. (82)

Alloy and Stainless Steels. Electric Steel Foundry Co., 102 pp, illus., No. 175-A. Catalog of ESCO alloy and stainless steels. Facilities for static, shell and centrifugal casting also described. (83)

Metal Stampings. Federal Tool & Mfg. Co., 4 pp, illus., No. 201. Information on small quantity metal blanking, forming, drawing, extruding, stenciling, drilling and tapping. (84)

Steel Tubing. Rochester Products Div., General Motors Corp., 12 pp, illus., No. 271. Typical applications of GM tubing made in both single and double walls of steel. (85)

Pearlitic Malleable Castings. Central Foundry Div., General Motors Corp., Saginaw, Mich., 70 pp, illus. Provides engineering data on Armasteel castings, plus machining and processing information. Write directly to GM.

Metal Stampings. Geometric Stamping Co., 4 pp, illus. Suggestions for cost savings through conversion from castings to stampings. (86)

Perforated Metal Sheets. Harrington & King Perforating Co., Inc., 6 pp, illus. Describes sizes, gages and materials of perforated metal sheets carried in stock. (87)

Powder Metal Parts. Keystone Carbon Co., 6 pp, folder. Describes powder metal products and production facilities. (88)

Wire. Keystone Steel & Wire Co., 12 pp, illus., No. 1a Ke. Illustrates the various kinds of wire available and provides information about the cold heading operation. (89)

Steel Castings. Lebanon Steel Foundry, 4 pp, illus. Case histories of two aircraft steel castings made by Lebanon's Ceramicast Process. (90)

Pressed Parts. Lenape Hydraulic Pressing & Forging Co. Catalog shows numerous parts press formed by this company illustrating the kinds of jobs this firm can perform. (91)

Wire Gage Chart. Little Falls Alloys Inc. Chart for determining gage and footage readings in Brown & Sharpe (AWG) wire gages. (92)

Metal Powder Parts. Lux Clock Mfg. Co., Inc., Powdered Metal Parts Div., 12 pp, illus. Case histories show advantages of using metal powder parts. Gives specifications for metal powder parts. (93)

Steel Wire. Pittsburgh Steel Co., 120 pp, illus. Sizes, tensile strength and chemical composition of approximately 100 types of steel wire are given. (94)

Metal Fabricating. Plume & Atwood Mfg. Co., 12 pp. Explains products and describes plant, equipment and skills offered by metal fabricator. (95)

To get manufacturers' literature use prepaid post card on pp 71 and 72.

Tool Steel. Vulcan Crucible Steel Div., H. K. Porter Co., Inc. Chart showing more than 300 varieties of tool steel offered by 12 producers. (96)

Investment Castings. Precision Metalsmiths, Inc., 12 pp, illus. Answers questions on precision castings and contains a comprehensive table of investment casting alloys and their properties. (97)

Deep Drawn Parts. Pressed Steel Tank Co., 16 pp, illus. Describes use of Hackney Metal containers and deep drawn component parts. (98)

Welded Steel Tubing. Revere Copper & Brass Inc., 12 pp. Discusses electric resistance welded steel tubing, including lengths, special shapes, types of finishes and types of steel. (99)

Metal Patterns. Rigidized Metals Corp., 4 pp, illus. *Rigid-Tex Metal News*, No. 3. Briefly discusses advantages and applications of metal patterns. (100)

Metal Stampings. Dayton Rogers Mfg. Co., 8 pp, illus. Metal stamping available, cost data, and facts regarding company's services are given. (101)

Stamped, Perforated Parts. Standard Stamping & Perforating Co., 114 pp, illus. Catalog of standard stamped and perforated patterns. (102)

Welded Tubing. Standard Tube Co., 8 pp, illus. Describes stainless steel pipe and tubing, mechanical steel tubing and boiler, condenser and other pressure tubing. (103)

Powder Metallurgy. F. J. Stokes Machine Co., 35 pp, illus. Shows how parts are made from metal powders and gives general and special applications of powder metallurgy. (104)

Stainless Steel Tubing. Superior Tube Co., 3 pp, illus., No. 2. Describes Weldrawn tubing. Sizes are listed in a table of analyses and production limits. (105)

Electronic Materials. Sylvania Electric Products, Inc., Tungsten & Chemical Div. Series of data sheets on tungsten, molybdenum, semiconductor, plated wire, chemical and phosphor products. (106)

Investment Castings. Kolcast Industries Inc., Div. of Thompson Products, Inc., 16 pp, illus. Describes the Kolcast process of investment casting and shows various parts made by this process. (107)

Steels. Timken Roller Bearing Co., Steel & Tube Div., Canton, Ohio. Complete catalog of steels. Write directly to Timken.

Constructional Alloy Steel. U. S. Steel Corp., illus. Gives properties and fabrication data for high strength, weldable steel. (108)

Metal Stampings. Volkert Stampings, Inc., 4 pp, illus., No. 1. "The Volkert View" features case histories of precision metal stamping. (109)

Stainless Steel Tubing. Wallingford Steel Co., 8 pp, illus. Stainless, carbon and alloy steel tubing for ornamental, mechanical, pressure, sanitary and aircraft use. (110)

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Metal Stampings. Worcester Pressed Steel Co., 8 pp, illus. Company facilities for custom metal stamping. (111)

Metal Powder Products. Yale & Towne Mfg. Co., Powdered Metal Products Div., 16 pp, illus. How Powdermet parts permit close tolerances, good wearability, controlled porosity and high ductility. (112)

Mechanical Tubing. Youngstown Sheet & Tube Co., 4 pp, illus. Features size and wall thickness of a complete line of Yoloy electric weld mechanical tubing. (113)

Nonferrous Metals • Parts • Forms

Aluminum Forgings. Aluminum Co. of America, 16 pp, illus. Specifications for standard aluminum hand forging alloys, recommended heat treatments and testing procedures. (119)

Engineering Bronzes. American Crucible Products Co., 12 pp, illus. Includes complete data on facilities, technical information, case histories and applications of Promet bronzes. (120)

Duplex Tubing. Bridgeport Brass Co., 14 pp, illus., No. 1954. Explains use of Duplex tubes for heat exchangers and condensers. (121)

Aluminum Castings. Centr-O-Cast & Engineering Co., Webb Wire Div., 4 pp, illus. Shows typical products: permanent mold, semipermanent and centrifugal aluminum castings. Sizes range from 2 oz to 65 lb. (115)

Data Chart. Cerro de Pasco Corp., illus. Wall chart of physical properties and applications of company alloys. (80)

Bimetals. W. M. Chace Co., 36 pp, illus. Describes and explains 22 uses of bimetals as actuating elements in temperature responsive devices. (122)

Die Pressed Brass Forgings. Chase Brass & Copper Co., 4 pp, illus. Three-dimensional photographs show the difference between the same parts made as die pressed brass forgings and as brass sand castings. (123)

Metal Powder Shapes. Amplex Div., Chrysler Corp., 52 pp, illus. Engineering manual includes data on properties of Oilite materials and lists Brinell and Rockwell hardness ratings for the materials. A 12-p insert lists over 1000 standard Oilite materials, including sleeve, flange and thrust bearings; cored and solid bar; and plate stock. (116)

Titanium. Rem-Cru Titanium, Inc., Div. of Crucible Steel Co. of America, 12 pp. Data sheet on Rem-Cru C-130 AM titanium. (124)

Die Castings. Dollin Corp., 16 pp, illus. Booklet describes plant and facilities for die castings. (125)

Nickel Electrical Alloys. Driver-Harris Co., 94 pp, charts, No. R-56. Comprehensive catalog of special electrical and resistance alloys and fine gage nickel alloy wire and strip. (126)

Aluminum Bronzes. Fansteel Metallurgical Corp., No. 15.100. Eighteen grades of aluminum bronze available in centrifugal, permanent mold and sand castings. Properties and applications. (127)

Copper and Brass Tubing. H & H Tube & Mfg. Co. Describes a complete line of copper and brass tubing. (128)

Die Castings. Precision Castings Co., Inc., Div. of Harsco Corp., 24 pp, illus. Describes facilities for producing aluminum, magnesium and zinc die castings. (129)

Aluminum Impact Extrusions. Hunter Douglas Aluminum Corp., 44 pp, illus. Gives a step-by-step description of backward and forward aluminum impact extrusions and shows some typical parts made from these extrusions. (130)

Metal Laminates. Improved Seamless Wire Co., 9 pp, illus. Describes lamination of precious metals to copper, brass, nickel, silver, Monel and pure nickel. (131)

Indium Alloys. Indium Corp. of America, 93 pp, graphs. "Constitution of Indium Alloy Systems" by E. A. Peretti, head, Dept. of Metallurgy Notre Dame Univ. (132)

Beryllium Copper Springs. Instrument Specialties Co., Inc., 16 pp, illus., No. 9A. Data on precision beryllium copper springs. Shows typical compression, flat and strip springs and contact strips and rings. (133)

Aluminum Extrusions. Kawneer Co., Aluminum Mill Products Div., 4 pp, illus. Describes facilities for producing shapes, rod, bar and tubing from aluminum. (134)

Lithium Metal, Compounds. Lithium Corp. of America. Data sheets on properties and uses of lithium metal and organic and inorganic lithium compounds. (135)

Thermostat Metals. General Plate Div., Metal & Controls Corp. Tables give major mechanical and physical constants for various thermostat metals. (136)

Brass Forgings. Mueller Brass Co., 33 pp, illus. Brass, bronze and aluminum forgings. Chemical, mechanical and physical properties of forging alloys, forging procedures, design factors and machining. (137)

Precious Metal Wire. J. M. Ney Co., 2 pp. Advantages of using Ney-Oro 6, precious metal wire for pivots in instrument bearings. (138)

Die Castings. Parker White Metal Co. Engineering data on die cast component parts. (139)

Aluminum Digest. Reynolds Metals Co., Desk ES, 2500 S. Third St., Louisville 1, Ky. *Reynolds Aluminum Digest* contains 50 to 60 reviews of articles relating to aluminum. Write directly to Reynolds.

Zinc Die Castings. St. Joseph Lead Co., 25 pp, illus. Discusses role of zinc as a base metal for die casting alloys and lists the variety of commercial finishes for zinc base die castings. (140)

Centrifugal Castings. Sandusky Foundry & Machine Co., 6 pp, illus. Specification chart for ferrous and nonferrous alloys for centrifugal castings. (141)

Aluminum Strip. Scovill Mfg. Co., 20 pp, illus. Physical characteristics, temperature designations, weights and fabricating data for aluminum alloy strip. (142)

Light Metal Castings. Thompson Products, Inc., Light Metals Div., 8 pp, illus. Describes a complete line of precision die castings for various industrial uses. (143)

Brazed Assemblies. Wall Colmonoy Corp., Wallco Mfg. Div., 4 pp, illus. Discusses Wallco facilities for design, development and manufacture of copper and silver brazed assemblies. (144)

Sintered Bearing Alloys. U. S. Graphite Co., Div. of Wickes Corp., 6 pp, illus., No. 18. Discusses design and metallurgical requirements for selecting sintered metal bearings. (145)

Nonmetallic Materials • Parts • Forms

Thermoplastic Material. Marbon Chemical Div., Borg-Warner Corp., 8 pp, No. CY-3. Discusses injection molding procedures for Cycolac, a thermoplastic multi-polymer plastic. (151)

Clear Rigid Plastics. Cast Optics Corp., 12 pp, illus. Lists uses, advantages and properties of five optically clear rigid plastics sheets. (152)

Impact Styrene Sheet. Chicago Molded Products Corp. Describes high-gloss surface finish for impact styrene sheet. Includes applications. (153)

Plastics Properties Chart. Commercial Plastics & Supply Corp., 4 pp, illus. Chart showing physical properties of polyethylene, methacrylate, polystyrene, nylon, Teflon, Vinylite and acetate. (154)

Felt Samples. Continental Felt Co., 4 pp, illus. Table of industrial felt specifications. Samples included. (155)

Plastics Pipe, Fittings. Corning Glass Works, No. PE-40. Physical properties, uses and specified dimensions of PVC pipe and fittings. (156)

Urethane Foams. Dayton Rubber Co., 15 pp, illus. Describes flexible as well as rigid urethane foams. (157)

Electric Motor Insulation. Dobeckmun Co., 4 pp, illus. Discusses Mylar, cellulose acetate and electrical papers for electric motor insulation. (158)

Foamed Styrene. Dow Chemical Co., Plastics Dept., 25 pp, illus. Properties of Styrofoam. an expanded polystyrene for structural insulation at low temperatures. (159)

Synthetic Elastomers. E. I. du Pont de Nemours & Co., Inc., Fabrics Div., 7 pp, illus. Properties and uses of various grades of Fairprene for sheet stock, coated fabrics and adhesives. (160)

Plastics for Lighting. E. I. du Pont de Nemours & Co., Inc., Polychemicals Dept., 11 pp, illus. Properties of Lucite acrylic resin and applications involving indoor and outdoor lighting. (161)

Plastics Injection Molding. Eastman Chemical Products, Inc., 51 pp, illus. Discusses injection molding of Tenite acetate and butyrate. (162)

Epoxy Adhesives. Emerson & Cuming, Inc., 8 pp, illus. Describes a line of epoxide adhesives, cements and sealants. (163)

Industrial Laminates. Farley & Loetscher Mfg. Co., Plastics Div., 8 pp, illus. Information on postformed laminates, engraving and nameplate stock, and printed circuit stock. (164)

Fiberglass Ducts. Arrowhead Products Div., Federal-Mogul-Bower-Bearings Inc., 16 pp, illus. Information on Airtron fiberglass ducts, sleeves and couplings. Describes five basic types and shows typical applications. (165)

Felt. Felters Co., 22 pp. Design properties, selection and applications of felt and felt products. (166)

Printed Circuit Materials. Formica Corp., 16 pp, illus. Covers the subjects of plated circuits, plating through holes, flush circuit production and circuit fabricating. (167)

PVC Pipe. Peter A. Frasse & Co., Inc., 8 pp, No. 13. Describes rigid unplasticized polyvinyl chloride pipe, fittings and valves. Covers properties, fabricating characteristics and economics. (168)

Silicone Selector. General Electric Co., Silicone Products Dept., 4 pp, illus., No. AA 24 E. Lists major categories and properties of silicone compounds. Cross references to AMS and ASTM specifications are included. (169)

Ceramic Materials. Globe-Union Inc., Centralab Div., 16 pp, illus. Gives advantages, production methods, specifications, design considerations and nomenclature for ceramic materials. (170)

Rigid PVC. B. F. Goodrich Chemical Co., 8 pp, illus. How rigid unplasticized polyvinyl chloride compounds Geon 8700-A and 8750 are used in making rigid vinyl pipe and fittings. (171)

Synthetic Rubber. Goodrich-Gulf Chemicals, Inc., 24 pp, illus. Discusses compounding and vulcanization of a line of cold non-oil and oil-extended polymers and hot polymers. (172)

Custom Made Rubber Parts. Goshen Rubber Co., Inc., 8 pp, illus. Representative products, fabricating operations and development of compounds. (173)

Glass Fiber Insulation. Gustin-Bacon Mfg. Co., 6 pp, illus. Gives physical properties, thermal conductivity, handling characteristics and acoustical efficiency values of "Ultrafine", a fine glass fiber insulation made of blown glass fibers. (174)

Insulating Material. Hays Mfg. Co., 12 pp, illus., No. 100. Properties of Haysite, a glass-reinforced alkyd-base polyester insulating material designed to meet rigid electrical standards. (175)

Phenolic Molding Compound. Durez Plastics Div., Hooker Electrochemical Co., 4 pp, illus. Information on a medium impact phenolic molding compound. Physical properties are listed and molding technique is discussed. (176)

Insulations. Johns-Manville Co., 20 pp, illus. Catalog of thermal insulations and refractories for temperature control from—400 to 3000 F. (177)

Fiberglass-Epoxy Tubing. Lamtex Industries Inc., 4 pp, illus. Data on Tuff-Tube, laminated fiberglass-epoxy tubing. (178)

Glass and Ceramic Parts. Mansol Ceramics Co., 16 pp, illus. Discusses glass preforms for hermetic seals, and shows preform and multiform production facilities. (179)

PVC Sheeting. Masland Duraleather Co., 4 pp, illus., No. 15-M. Gives uses for Duran Clad, a semirigid vinyl sheeting for laminating to steel and nonferrous metals. Contains samples of the material. (180)

Insulation. Mica Insulator Co., 12 pp, illus. Description, application and physical and electrical properties of Isomica insulating material and Samica sheet mica and Isomica tapes and tubes. (181)

Polyester Film. Minnesota Mining & Mfg. Co., Reinforced Plastics Div., 6 pp, illus. Describes development of Scotchpak polyester film and shows various applications of the material. (182)

Urethane. Mobay Chemical Co., 16 pp, illus. Pictures applications of urethane and outlines its possibilities for use in synthetic rubber and adhesives. (183)

Fiberglass-Reinforced Plastics. Molded Fiber Glass Co., 16 pp, illus. Describes custom molding services. Lists fabricating operations and mechanical, electrical and chemical properties of molded fiberglass. (184)

Glass-Bonded Mica. Mycalex Corp. of America, 24 pp, illus. Gives physical, electrical and thermal properties, and discusses molding, machining, and dimensional tolerances of ceramoplastics and glass-bonded micas. (185)

Foamed Plastic. Nopco Chemical Co. Suggested application of Nopco-foam, a flexible foamed plastics. (186)

Sealing Compounds. Presstite Keystone Engineering Products. Pictures and captions show many sealing compound applications, including watertight sealing of automobile drip rails and moisture-proofing of refrigerator heater wire assemblies. (187)

Carbon Graphite. Pure Carbon Co., Inc., 12 pp, illus., No. 55. Catalog on carbon graphite for mechanical applications. (188)

Rubber Linings. Manhattan Rubber Div., Raybestos-Manhattan Inc., 12 pp, illus., No. 7115. Discusses corrosion, abrasion and contamination resistant rubber linings for storage and process equipment. (189)

Polyester Resins. Reichhold Chemicals, Inc. Describes Polylite liquid thermosetting polyester resins suitable for use in glass fiber-reinforced applications. (190)

To get manufacturers' literature use prepaid post card on pp 71 and 72.

Plastics Hose. Resistoflex Corp., 4 pp. Flexible hose, assemblies and plastics products for heat and chemical resistance applications. (191)

Molded Plastics. Richardson Co., 8 pp, illus. Manual on molded plastics for automotive, electrical, appliance and industrial applications. Case histories of 12 different applications. (192)

Gasket Materials. Rogers Corp., 13 pp, illus. File folder on the company's line of gasketing material for electrical insulation, gaskets and filters. Lists basic and custom grades and forms available. (193)

Paper Chemicals. Rohm & Haas Co., 2 pp. Revised price list for paper chemicals incorporating reductions in price of several products. (205)

Adhesives for Plastics, Metals. Rubber & Asbestos Corp. Data chart lists technical data, form, viscosity, curing time and temperature and applications for 30 adhesive formulations. (194)

Laminated Plastics. Panelyte Div., St. Regis Paper Co., 19 pp, illus., No. 1-d-PA. Industrial, chemical and decorative applications of Panelyte structural laminated resinous plastics. (195)

Plastics Moldings. Shaw Insulator Co., 12 pp, illus. Details facilities for custom molding of plastics. (196)

Teflon Parts. Sparta Mfg. Co., Div. of U. S. Ceramic Tile Co., 4 pp, illus. Information on molding Teflon into cups, seals, washers, gaskets and diaphragms. Property chart lists physical, mechanical, electrical and thermal properties. (198)

Tetrafluoroethylene. U. S. Gasket Co., No. 300. Tables and descriptive matter on chemical, electrical, thermal and mechanical properties of Teflon. (199)

Plastics, Synthetic Rubber. Naugatuck Chemical Div., U. S. Rubber Co., 36 pp, illus. Outlines properties and uses of synthetic rubber, reclaimed rubber, natural and synthetic latex, thermoplastic materials and PVC resins. (200)

Plastics Pipe. National Tube Div., U. S. Steel Corp., 28 pp, illus., No. 24. Data on unplasticized rigid polyvinyl chloride pipe, both normal and high impact types. (201)

High Temperature Ceramics. U. S. Stoneware Co., Alite Div., 7 pp, No. A-7. Describes physical and high temperature properties, methods of joining and electrical characteristics of Alite, a sintered aluminum oxide. (202)

Nylon Screws. Weckesser Co., 3 pp, illus. Describes black nylon screws and nuts and gives application data. (203)

Wood Panel Stock. Weyerhaeuser Timber Co., Special Products Div., 4 pp, illus. Typical applications and sizes, grades and prices of a lightweight laminated wood panel stock. (204)

Finishes • Cleaning and Finishing

Ultrasonic Cleaning. Pioneer - Central Div., Bendix Aviation Corp., 8 pp, illus. Folder describes ultrasonic cleaning process and equipment. (210)

Enameled Metal Strip. Coated Coils Corp., 4 pp, illus. Describes coiled enameled metal strip supplied in widths up to 30 in. Strip can be put through operations without damaging the coating. (211)

Metallic Coatings for Plastics. Coating Products. Attractive brochure describes the various coatings applied to plastics materials. Samples included. (212)

Abrasives. Elgin National Watch Co., Abrasives Div., 4 pp, illus. Describes Dymo-C, a diamond abrasive for finishing carbide dies. (213)

Solution Coating Resin. Firestone Plastics Co., Chemical Sales Div., 8 pp, No. 13. Properties and uses of Exon 450 vinyl chloride co-polymer resin for solution coatings, either permanent or strippable. (214)

Vinyl Lacquers. Davison Chemical Co., Div. of W. R. Grace & Co., 5 pp. Technical bulletin on use of Syloid 244 for flatting vinyl lacquers to give a low gloss effect. (215)

Bonding and Coating. Angier Adhesives Div. of Interchemical Corp., 13 pp, illus. Manufacturing facilities, laboratory control and custom service for solving problems in bonding and coating. (216)

Multicolor Enamel. Maas & Waldstein Co., 2 pp, No. 520. Data sheet for industrial multicolor enamels. (217)

Coatings, Adhesives. Magic Chemical Co. Catalog of Magic-Vulc protective coatings and Peerless industrial adhesives. (218)

Localized Plating. Marlane Development Co., Inc., 13 pp, illus. Describes Dalic process of selective electroplating. Included are metallurgical characteristics of the plate and a list of major applications. (219)

Corrosion Prevention. Metallizing Engineering Co., Inc., 4 pp, illus. Description of Metco Systems and how these pure metallized zinc or aluminum coatings prevent corrosion. (220)

Protective Coatings. Michigan Chrome & Chemical Co., 8 pp, illus. Describes coating materials for tanks, molds and fixtures used in plating systems. (221)

Colored Silicone Finishes. Midland Industrial Finishes Co., illus. An interesting discussion of the applications of colored silicone finishes. (222)

Paint Stripping. Oakite Products, Inc., 14 pp, illus. Procedures followed in four different stripping methods: steam gun, hot flow-on, cold spray and tank. (223)

Barrel Finishing. Almco Div., Queen Stove Works, Inc., 52 pp, illus. Outlines how company's barrel finishing method operates and lists barrels, equipment and supplies. (224)

Electrostatic Spray Painting. Ransburg Electro-Coating Corp., 16 pp, illus. Typical on-the-line examples of the Ransburg No. 2 process of electrostatic spray painting. (225)

Metal Finishing. Roto-Finish Co., 6 pp, illus. Folder describes precision finishing process and various types of machines developed for diverse job requirements. (226)

Electroplating Data Chart. Technic Inc. Chart giving electroplating data on precious metals such as gold, palladium, platinum, rhodium and silver. (227)

Cathodic Protection. National Carbon Co., Div. of Union Carbide & Carbon Corp., 12 pp, illus., No. S-6500. Discusses a cathodic protection system using graphite anodes for underground pipes. (228)

Finishing Forgings. J. H. Williams & Co., 20 pp, illus. Describes company's facilities for all phases of forging, including cleaning and finishing. (229)

Methods and Equipment • Parts • Forms

Muffles, Retorts. Electro-Alloys Div., American Brake Shoe Co., 6 pp, illus., No. T-239. Describes heat resistant muffles and retorts and outlines corrosion and abrasion resistance features. (235)

Hardness Testing. Wilson Mechanical Instrument Div., American Chain & Cable Co., Inc., 12 pp, illus., No. DH-328. Describes Tukon Testers for micro and macro hardness testing. (236)

Stereoscopic Microscopes. American Optical Co., Instrument Div., 32 pp, illus. Information on A. O. Spencer stereoscopic microscopes. Lists prices, accessories and specifications. (237)

Silver Brazing. American Platinum Works, 16 pp. Manual on selective fluxing for low temperature silver brazing. (238)

Echelle Spectrographs. Bausch & Lomb, 23 pp., illus. Catalog shows how the echelle type spectrograph works, what it does and its instrumentation. (239)

Gamma Radiography. Budd Co., Nuclear Systems Div., 20 pp, illus. Gives specifications, operation, construction and safety features of a line of gamma radiography equipment. (240)

Rivets. Chicago Rivet & Machine Co., 16 pp, illus., No. 42. Catalog lists almost 1400 standard precision-made semitubular, full tubular and split rivets. (241)

Bolt and Forging Products. Columbus Bolt & Forging Co., 40 pp, illus. Describes facilities for producing assembly parts for the bolt and forging industries. (114)

Ultrasonic Inspection. Curtiss-Wright Corp., Industrial & Scientific Products Div., 4 pp, illus. Discusses ultrasonic testing and how it may be applied to materials inspection. (242)

Grooved Fasteners. Driv-Lok Pin Co., 24 pp, illus. Catalog of Driv-Lok pins and studs and precision Lok-Dowels. (243)

Industrial Radiography. E. I. du Pont de Nemours & Co., Inc., Photo Products Dept., 24 pp, illus. X-ray films, chemicals and screens for industrial radiography. (244)

Screws. Elco Tool & Screw Corp., 4 pp, illus. Information on screws, bolts, threaded products and cold headed products. (245)

Temperature Controls. Claude S. Gordon Co., 4 pp, illus. Brief description and advantages of a straight line, fully automatic temperature control. (246)

Lock, Weld and Clinch Nuts. Grip Nut Co., 12 pp, illus. Specifications and applications for Gripco fasteners. (247)

Inserts. Groov-Pin Corp. Self-tapping insert used as original equipment and for salvage and repair of stripped threads. (248)

Fasteners. H. M. Harper Co., 16 pp, illus. Describes nonferrous and stainless steel fasteners. (249)

Blind Rivet. Huck Mfg. Co., 4 pp, illus. Describes drive pin blind rivet. Specifications given. (250)

Sintering Furnaces. Lindberg Engineering Co., 8 pp, illus., No. 230. Describes various types of sintering furnaces. (251)

Carbon Dioxide Welding. Liquid Carbonic Corp., Compressed Gas Div., 21 pp, illus. Information on metallic arc-gas shielded welding with carbon dioxide. (252)

Induction Heating Equipment. Tocco Div., Ohio Crankshaft Co., 20 pp, illus., No. 22-G. Describes induction heating equipment, including motor-generator, electronic tube and special type machines. (253)

Modern Testing. Tinius Olsen Testing Machine Co., 25 pp, illus. Traces major advances in design of testing and balancing equipment since 1880. (254)

Lock Screw Fasteners. Russell, Burdsall & Ward Bolt & Nut Co., 3 pp, illus. Advantages and dimensions of spinlock screws. (255)

Locknuts. Security Locknut Corp., 4 pp, illus. Specifications and ordering information on the company's line of large standard nuts, jam and slotted nuts, and locknuts. (256)

Quality Control. Spectrochemical Laboratories, Inc., 4 pp, illus. Information on quantometric, spectrographic and wet chemical analysis of ferrous, nonferrous and nonmetallic materials. (257)

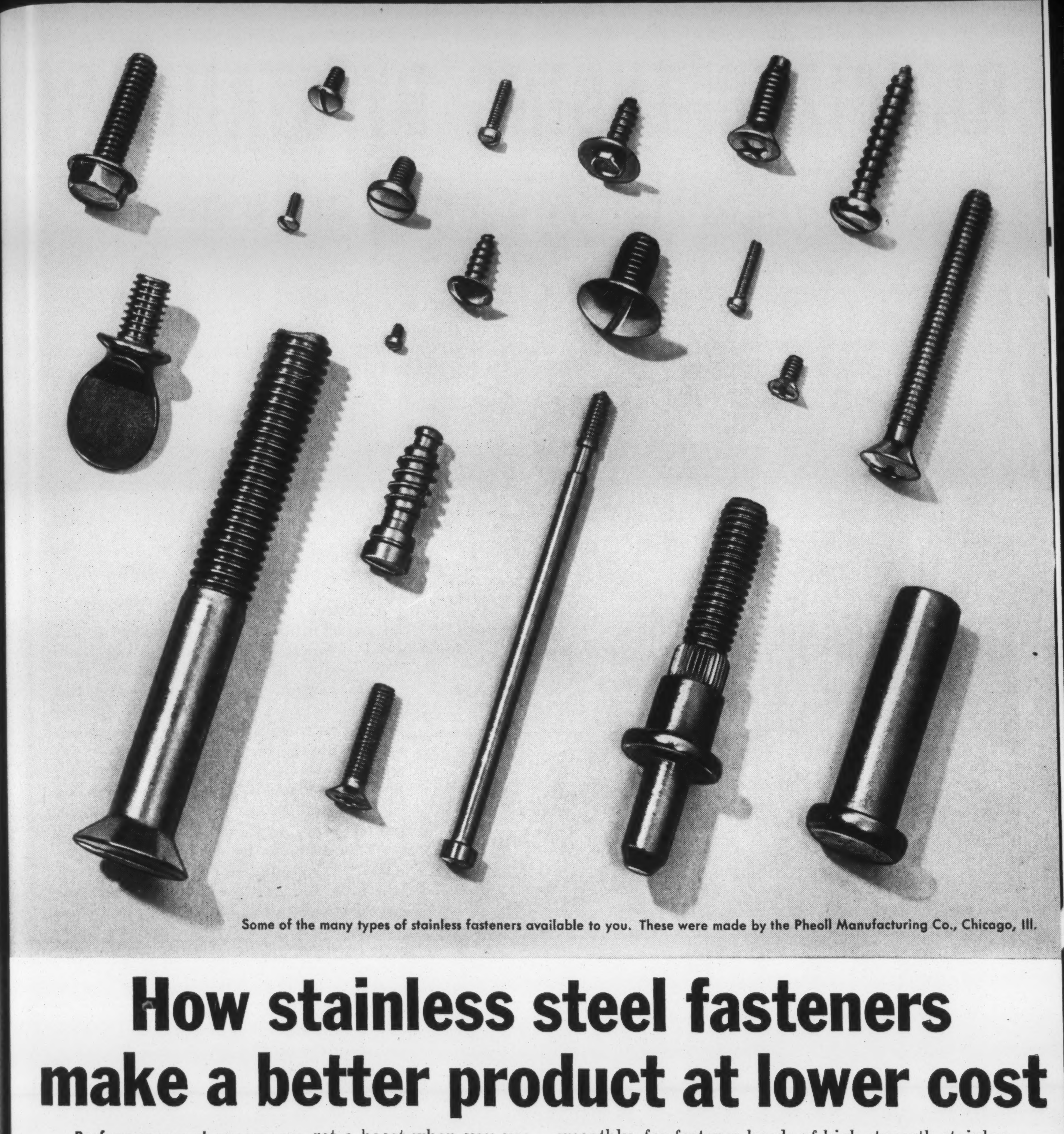
Tool, Dies, Plastics Molds. Sylvania Electric Products, Inc., Parts Div., 11 pp, illus. Describes facilities for design, engineering and manufacture of tools, dies and molds for plastics. (258)

How to Braze. United Wire & Supply Corp., Brazing Alloy Div., 4 pp, illus. Directions on how to braze threadless fittings to seamless tubing to obtain a strong, noncorrosive, pressure tight joint. (259)

Electric Heaters. Edwin L. Wiegand Co., 4 pp, illus., No. 850. Discusses electric cartridge heaters for applying localized heat to work areas requiring close thermal control, such as dies, platens and molds. (260)

To get manufacturers' literature use prepaid post card on pp 71 and 72.

For more information, Circle No. 385 ➤



Some of the many types of stainless fasteners available to you. These were made by the Pheoll Manufacturing Co., Chicago, Ill.

How stainless steel fasteners make a better product at lower cost

Performance and appearance get a boost when you use stainless steel fasteners. For stainless resists rust, heat and corrosion. It keeps its good looks for a lifetime. Stainless-fastened products won't be marred by unsightly rust streaks—and they can be dis-assembled and assembled quickly and easily even after years of all-weather service.

Stainless helps keep production costs down. Work goes smoothly, for fastener heads of high-strength stainless are less apt to burr or nick. And there's no plating on stainless for a careless tool to chip or scrape away.

You cut tooling costs, too. For now stainless fasteners are promptly available in just about *any* size or description—and in any of the 200, 300, or 400 Rezistal stainless series. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

PRODUCTION MEN: If you use stainless steel cold heading wire, Crucible can fill your needs quickly and dependably. It is regularly supplied in all diameters and standard grades, and in a variety of finishes. For more information write for your free copy of the 32-page booklet, "Rezistal Stainless Steel Wire."

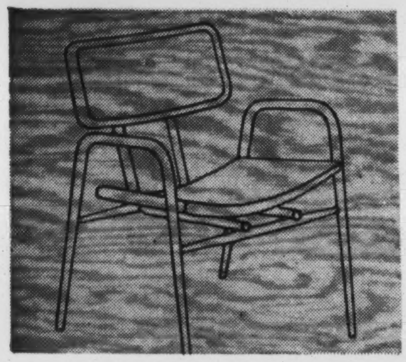
CRUCIBLE first name in special purpose steels

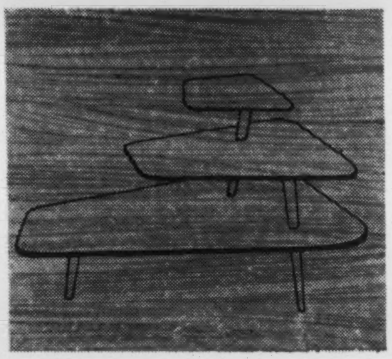
Crucible Steel Company of America

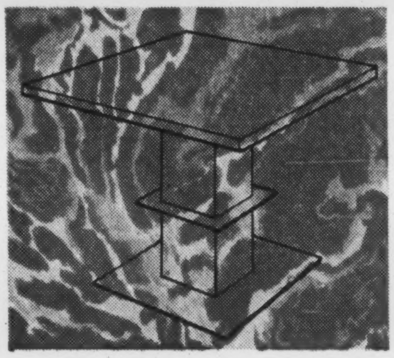
Canadian Distributor—Railway & Power Engineering Corp., Ltd.

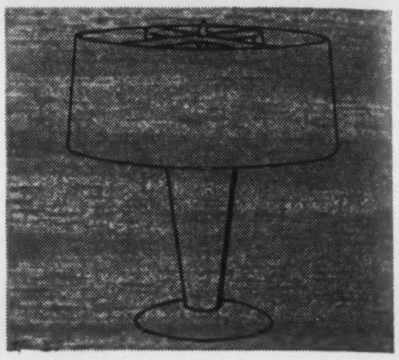
RIGIDIZED TUBING BY STANDARD

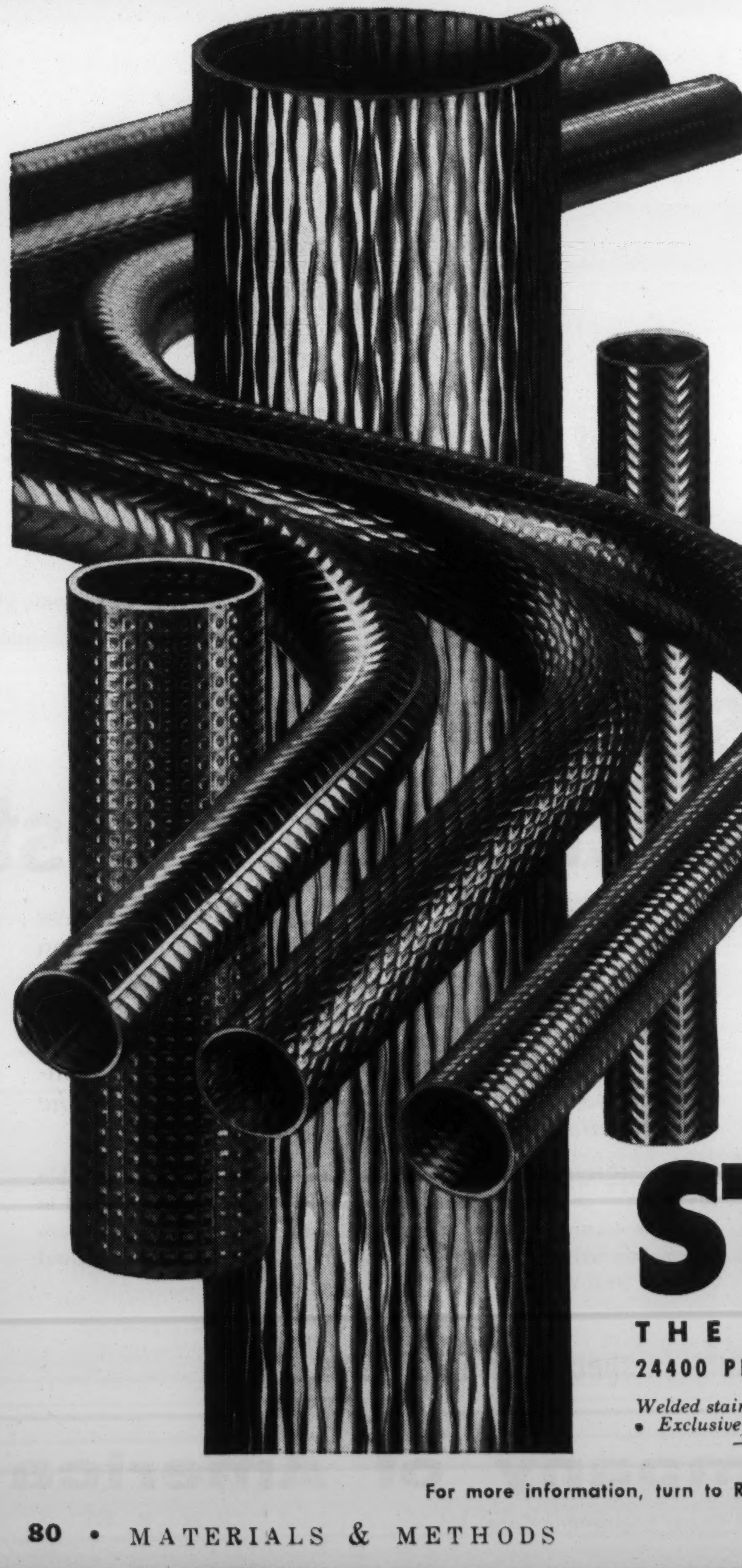
customized for you in "1001" patterns









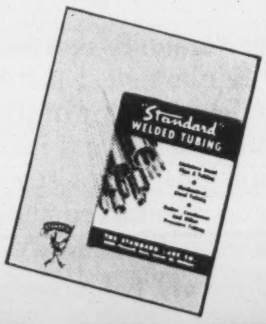


For volume users of tubing—

Hundreds of exciting new patterns in rigidized tubing can be made up to add novel beauty, strength and individuality to your products. Textures and motifs to match fabrics, woods, materials and finishes of all kinds. In round, square, rectangular or special shaped tubing. And manufacturer sharing the cost of design development depending, of course, on volume of order. Custom patterns such as—nubby weaves, rustics, striateds, knotty pine, corrugated, herring-bone, ripple wood, swirls, scrolls, geometrics—can be designed to your specifications. Gleaming chrome or duo-tone enamel finishes. Unlimited pattern designs! Unlimited uses! You are limited only by your own imagination. Sizes range from ½″ to 5½″ OD in 16 gauge and lighter carbon steel tubing . . . and to 4″ OD stainless steel.

Standard also offers full line of carbon and stainless tubing and pipe—for everything from simple *structural* to precision *mechanical* and *pressure* applications.

FREE 8-page folder on all Standard products. Write to address below.



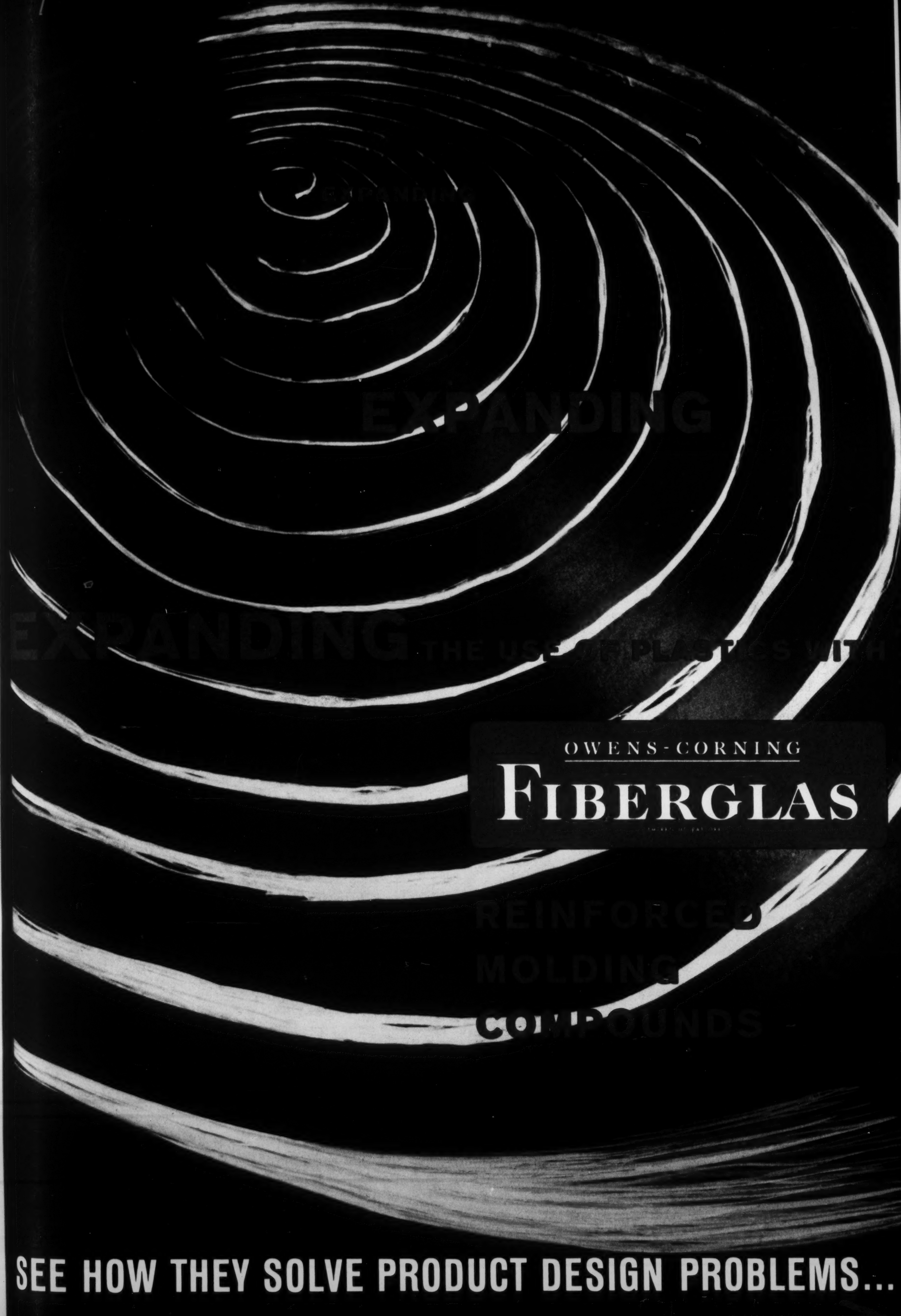
STANDARD

THE STANDARD TUBE COMPANY

24400 PLYMOUTH ROAD • DETROIT 39, MICHIGAN

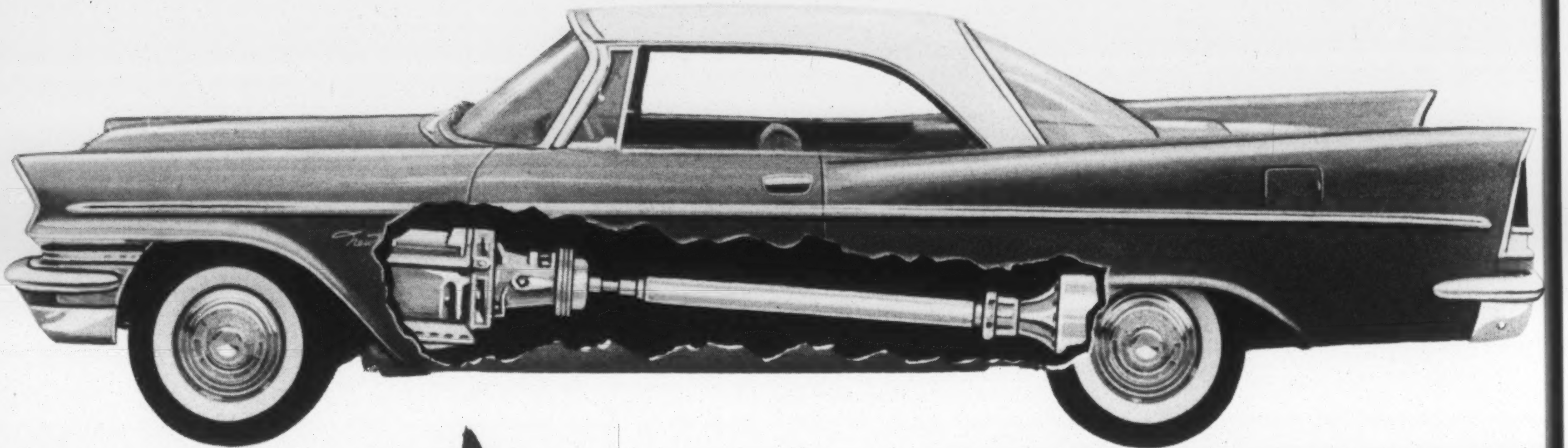
Welded stainless tubing and pipe • Welded carbon steel mechanical • Boiler and Heat Exchanger • Exclusive rigidized patterns • Special Shapes • Steel Tubing—Sizes: ½″ OD to 5½″ OD —.028 to .260 wall • Stainless—Sizes: ¼″ OD to 4″ OD—.020 to .154 wall.

For more information, turn to Reader Service Card, Circle No. 447


EXPANDING
EXPANDING
EXPANDING THE USE OF PLASTICS WITH
OWENS-CORNING
FIBERGLAS
T.M. REG. U.S. PAT. OFF.
REINFORCED
MOLDING
COMPOUNDS
SEE HOW THEY SOLVE PRODUCT DESIGN PROBLEMS...

ALL THE PROPERTIES OF PLASTICS...PLUS

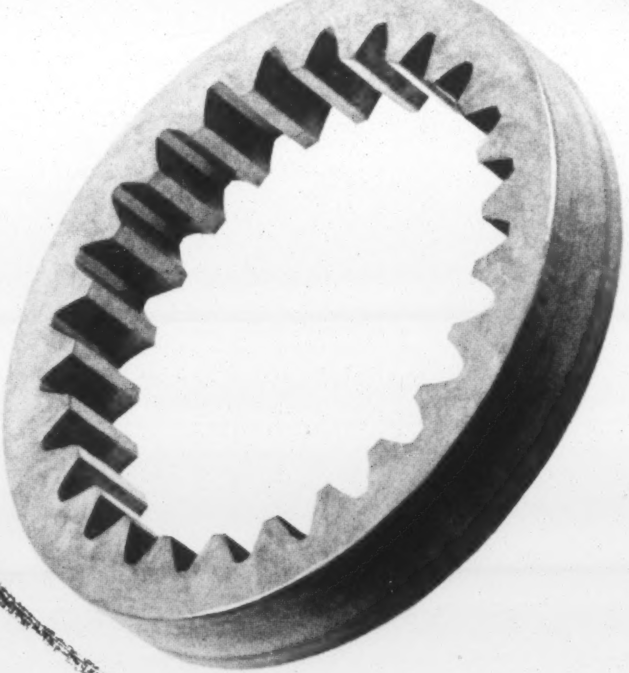
- ✚ Heat Resistance
- ✚ Strength
- ✚ Dimensional Stability



Carries the load under heat and pressure . . .

Deep down inside every new Chrysler, you'll find this hard-working gear molded of Fiberglas-reinforced phenolic. It's a vital part of a pump which maintains high hydraulic oil pressure to operate the Chrysler's POWER-FLITE and TORQUEFLITE transmissions.

Every property of Fiberglas-reinforced molding compounds is put to the test in this application. To do its job, the gear must show super strength, wear resistance, heat resistance and dimensional stability. Fiberglas-reinforced phenolic measures up on every score. Not only has this molded gear resulted in substantial cost savings, but it also makes much less noise than the metal gear it replaces.



END USER: Chrysler Corporation, Detroit, Michigan

MOLDER: Willow Run Rubber & Lining Company, Belleville, Michigan

MOLDING COMPOUND: Durez Fiberglas-reinforced phenolic by Durez Plastics Division, Hooker Electrochemical Company, North Tonawanda, N.Y.

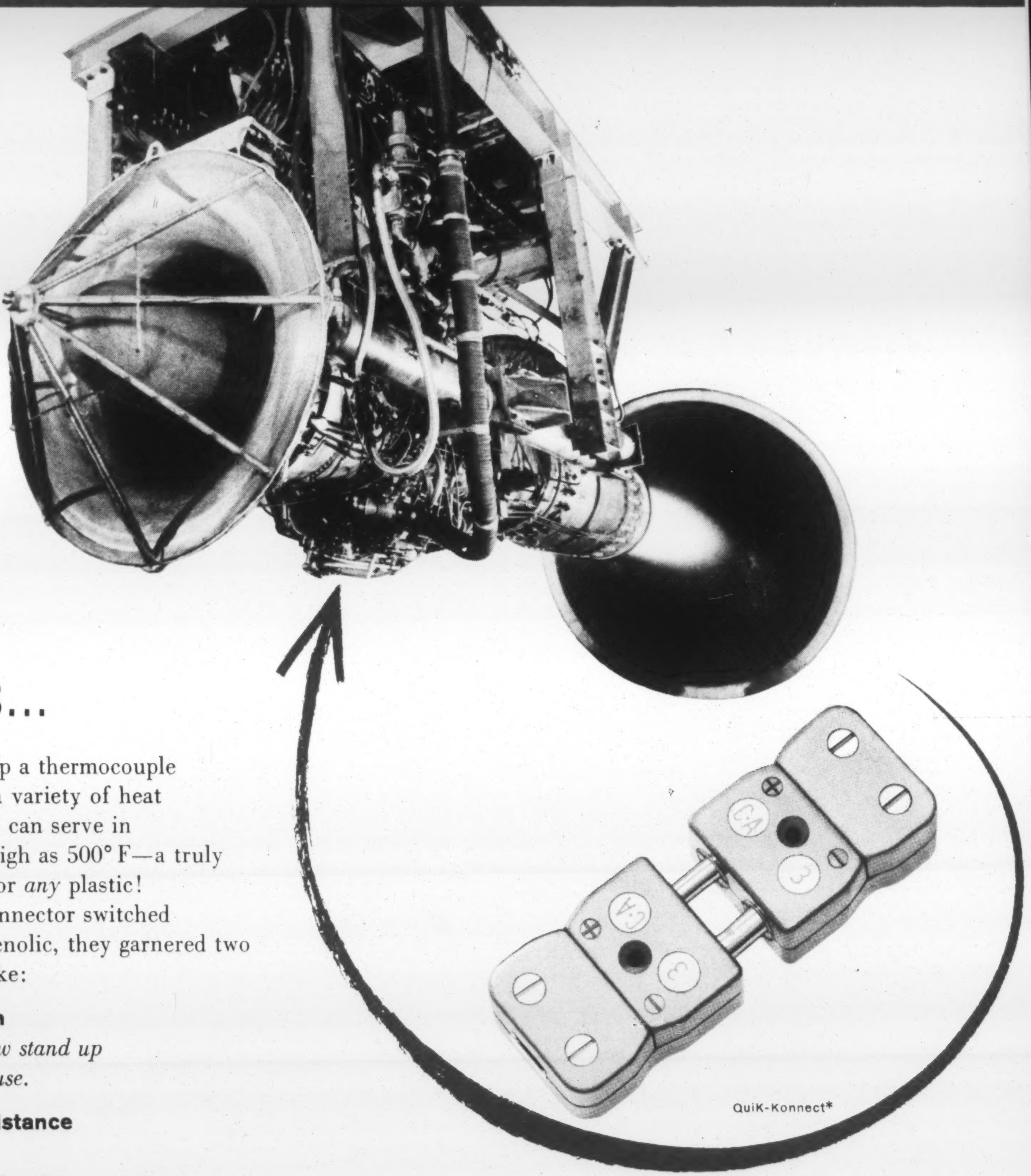
OWENS-CORNING
FIBERGLAS*

REINFORCED

*T.M. (Reg. U.S. Pat. Off.) O-C. F. Corp.

PLASTIC MOLDING COMPOUNDS with Fiberglas reinforcement have surmounted many of the limitations which molded plastics impose on the designer. For Fiberglas-reinforced molding compounds make products that are far stronger . . . more resistant to temperature extremes . . . with better dimensional tolerances and stability than have ever before been possible. In effect, they are opening up a whole new world of design opportunities.

Yet Fiberglas-reinforced molding compounds have all the good properties, processing advantages and economies you associate with molded plastics. They're formed in standard transfer, injection or compression molding equipment and introduce no new problems in handling or processing. On these pages, you see a few of the many new products designed with Fiberglas-reinforced molding compounds to attain all the properties of plastics . . . plus!



QuiK-Konnect*

Measures white heat at close quarters...

This plug and jack make up a thermocouple connector widely used in a variety of heat measurements—both parts can serve in ambient temperatures as high as 500° F—a truly astonishing performance for *any* plastic! When designers of this connector switched to Fiberglas-reinforced phenolic, they garnered two big advantages at one stroke:

1. Much greater strength
means the connector can now stand up through years of everyday use.

2. Spectacular heat resistance
enables the connector to be used much closer to the heat source . . . means much more accuracy in measurement.

Here you see an excellent example of the improvement in plastics performance that stems from Fiberglas-reinforced molding compounds. The molding operation on these parts is normal. The complicated shapes are transfer-molded from pre-formed pills in standard equipment.

MOLDER: Marlin Manufacturing Co., Cleveland 11, Ohio

PRODUCT MANUFACTURER: Minneapolis-Honeywell Regulator Co., Brown Instrument Division, Philadelphia, Pa.

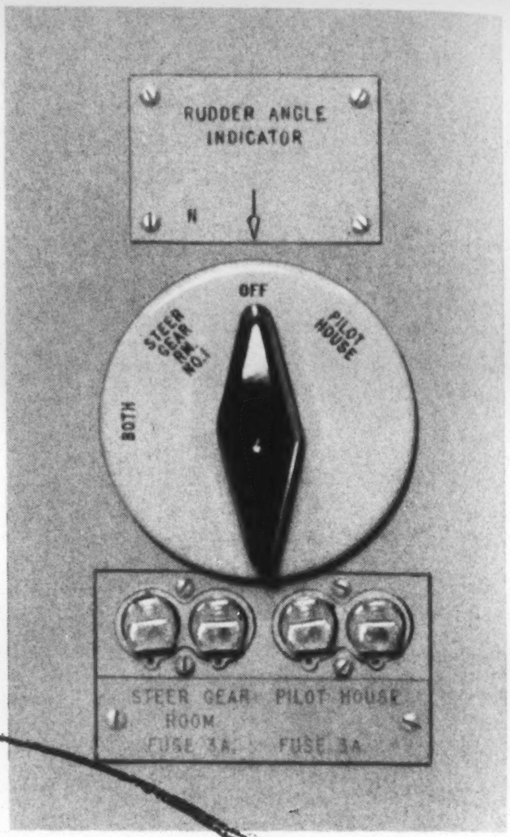
MOLDING COMPOUND: Fiberglas-reinforced phenolic by Fiberite Corporation, Winona, Minn.

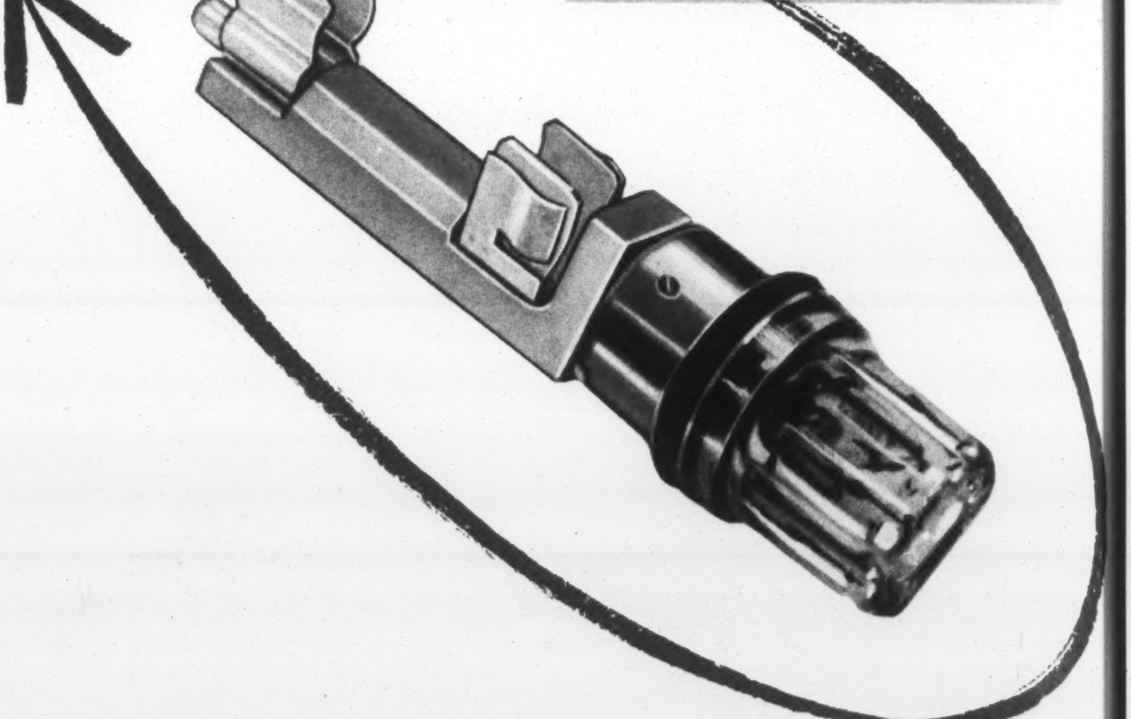
*Trademark, Minneapolis-Honeywell Regulator Co.

MOLDING COMPOUNDS

ALL THE PROPERTIES OF PLASTICS...PLUS

- ✚ Heat Resistance
- ✚ Strength
- ✚ Dimensional Stability





Alarm light for a blown fuse

When the fuse blows inside this fuse holder, a light glows and the trouble can be quickly corrected. These holders are now widely used on switchboard and control panels in industry, aboard ship and in military aircraft.
Designers of this assembly needed a material that combines shock resistance with excellent dielectric properties. And since the fuse carrier must fit snugly into the base, dimensional stability is also important. Fiberglas-reinforced alkyd fills these requirements and, in addition, offers high resistance to heat, moisture and electric arcing. Again, a Fiberglas-reinforced molding compound makes a new design possible!

PRODUCT MANUFACTURER: Fuse Indicator Corporation, Boston, Mass.

MOLDER: Engineered Plastics, Inc., Watertown, Mass.

MOLDING COMPOUND: Fiberglas-reinforced Plaskon Alkyd by Barrett Division, Allied Chemical & Dye Corporation, New York, N.Y.

THE CASE HISTORIES
on these pages illustrate just a few of the thousands of products which have been profitably fabricated with Fiberglas-reinforced molding compounds. Write now for our complete file of case histories and a list of suppliers of Fiberglas-reinforced molding compounds.

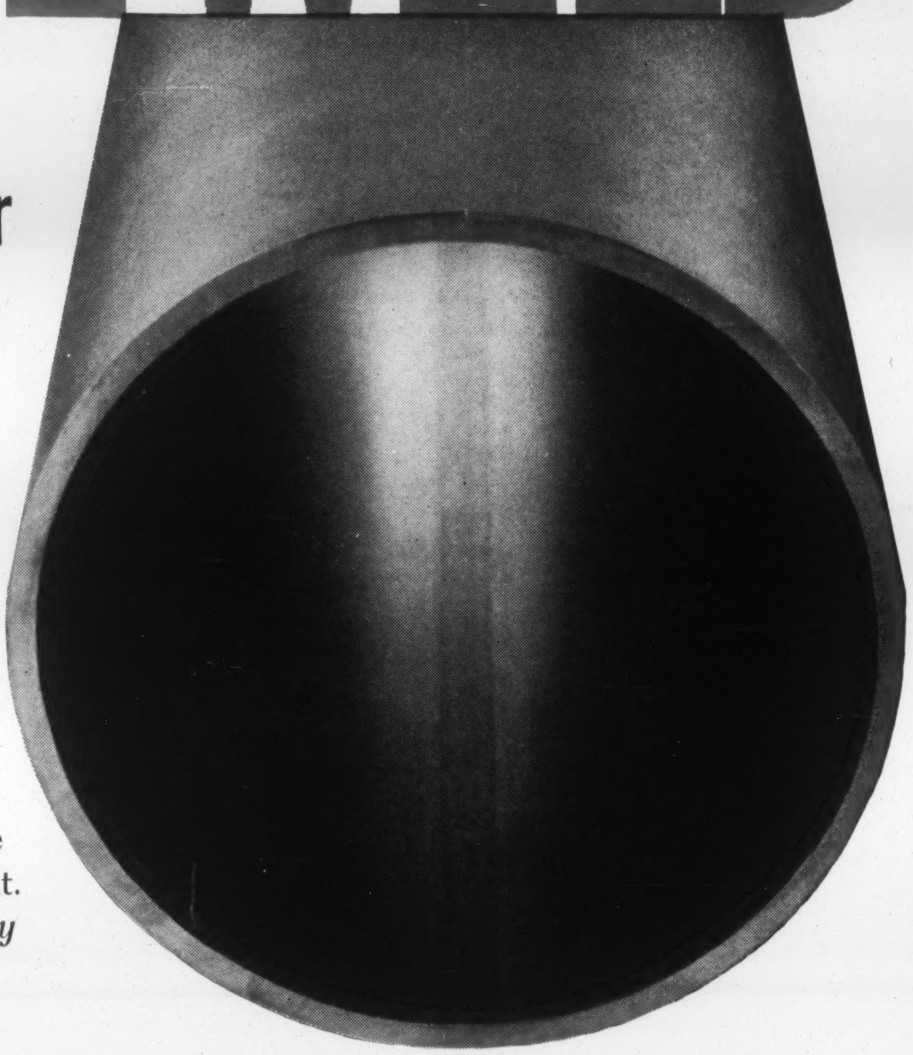
TEXTILE PRODUCTS DIVISION
Dept. 216-F, 598 Madison Ave., N.Y. 20, N.Y.

Owens-Corning Fiberglas Corporation produces only the reinforcement for the manufacturers of reinforced molding compounds.

OWENS-CORNING
FIBERGLAS

Owens-Corning Fiberglas Corporation produces only the reinforcement for the manufacturers of reinforced molding compounds.

CONTOUR-TRENTWELD



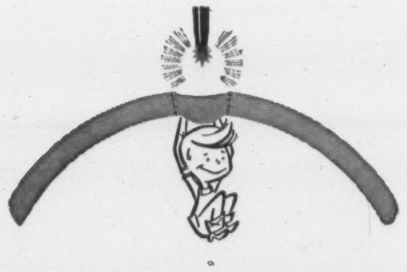
welded stainless pipe that's smoother, stronger

New Contour-Trentweld outperforms any other pipe, welded or not. Here's why: *Contour-Welding* is an entirely unique method of producing pipe and tubing. It puts gravity to work to pull down the molten weld metal until it exactly conforms to the contour of the pipe. Result: A smooth pipe or tube free of undercut or bead.

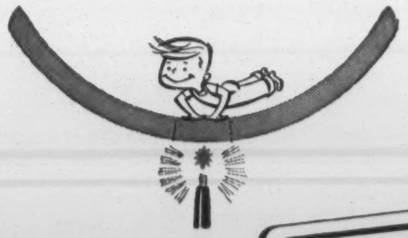
What's more, the *Contour-Weld* process *starts* with uniformly rolled stainless strip, which insures constant wall thickness throughout the pipe.

But the only way you can fully appreciate the advantages of new *Contour-Trentweld* is to try it. We think you'll agree, *it can't be beat by any other pipe, welded or not.*

Why Trent's Exclusive Contour-Welding Process Means Smoother Welds . . .



Normally, in producing welded pipe, the weld is made at the top. But gravity plays a nasty trick. It tugs at the fluid metal in the weld zone, pulling it down toward the middle of the pipe. The result, particularly in the heavier gages, is a perceptible bulge where it hurts the most — right on the I.D. surface. If you try to get rid of the bulge — at fair cost — the metal is undercut — and corrosion and erosion start there.



But Trent put a stop to that — simply by going into partnership with gravity. With their exclusive *Contour-Welding* process, they weld at the bottom — and gravity works for them. For then, the bulge is in the opposite direction — blending in perfectly with the contour of the pipe itself.

CONTOUR TRENTWELD

Stainless and High Alloy Welded Tubing

TRENT TUBE COMPANY, GENERAL SALES OFFICES, EAST TROY, WISCONSIN (Subsidiary of Crucible Steel Company of America)

◀ For more information, Circle No. 567

For more information, turn to Reader Service Card, Circle No. 557

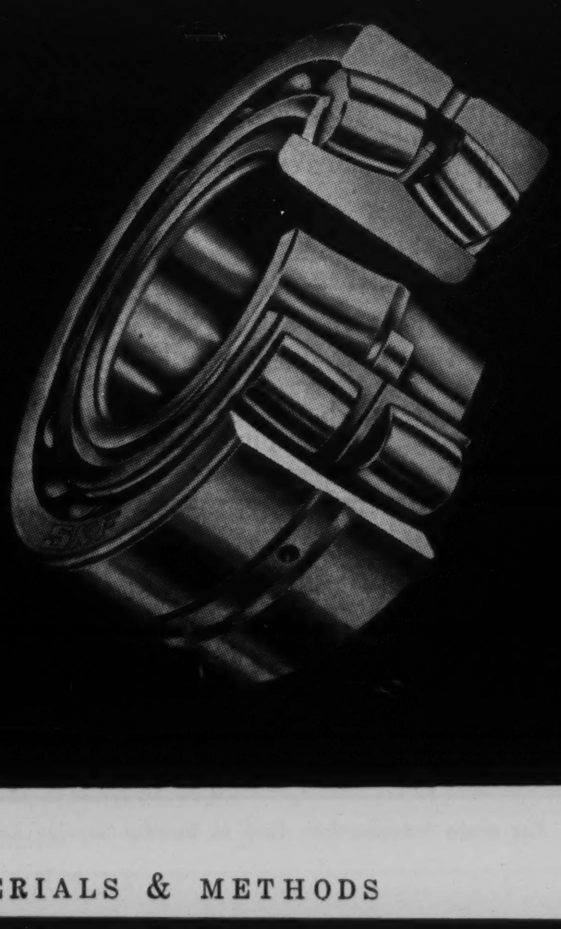
How SKF Saved in 7 Ways

and at the same time improved its roller bearing cages by using the right

Revere Brass Strip

SKF Industries, Inc., Philadelphia, Pa., like other progressive organizations, is constantly seeking new ways to improve its products and at the same time cut production costs.

With this in mind they recently reviewed the kind of brass which was being used in their spherical roller bearing cages from the standpoints of quality and fabrication. It was then that Revere's Technical Advisory Service studied the problem first-hand and made recommendations to the **SKF** production and engineering departments.



SKF IMPROVED TYPE "C" Spherical Roller Bearing cut away to show how the cage, made of Revere Brass Strip, fits into the bearing. Due to its advanced internal design, this bearing provides greatly increased capacity and service life.

HERE IS "window-type" cage of **SKF** Spherical Roller Bearing, made in two pieces, one for each row of rollers. Cage is made from rugged Revere Brass Strip at the Shippensburg, Pa., plant of **SKF** Industries, Inc.

The result was the adoption of specification changes in brass strip as recommended by Revere which gave **SKF** these 7 money, time and tool-saving advantages:

1. One bore pressing operation has been eliminated. Machining is more easily accomplished. Less machining is required.
2. Tool life has been increased with some speeds increased up to 100% and feeds up to 30%.
3. Rework due to burrs has been greatly reduced. One step less is required in the deburring operation while savings through reduced cycle time for remaining deburring operations are up to 40%.
4. Chips are small now . . . there is no "angel hair" to clutter work area.
5. Life of punch used in notching roller bearing cage has been doubled. Now a run may be completed without making tool adjustments due to sharpening tools.
6. Machining speeds and feeds have been substantially increased over those in machining the former alloy.
7. Die setters report that considerable work has been eliminated in setting up the tools used.

And, all of these money-saving things were accomplished without sacrificing quality—in fact the quality of these roller bearing cages was *improved!*

This is still another eye-opening example of Revere supplying the metal that will do the best job and with the greatest economy . . . be it brass, copper or aluminum or any one of their alloys.

Why not call in Revere's Technical Advisory Service to review your operation? It may mean money saved with an improved product to boot.

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801
230 Park Avenue, New York 17, N.Y.

Mills: Baltimore, Md.; Brooklyn, N.Y.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Newport, Ark.; Rome, N. Y. Sales Offices in Principal Cities, Distributors Everywhere.

For more information, turn to Reader Service Card, Circle No. 551

how Vacuum Metals FERROVAC solved critical surface problem for Bausch & Lomb . . .

The jewelers' rolls Bausch & Lomb use to roll gold-alloy wire for eyeglass frames must be *mirror-smooth.* Rolls of conventional air-melted alloys just didn't work out economically. A normal amount of nonmetallic inclusions in the metal meant they had to be ground and reground, polished and repolished, before the surface was satisfactory. And even then, many rolls had to be scrapped when finishing uncovered inclusion pits.

The solution to this problem proved to be Vacuum Metals FERROVAC® Airdi 150. A better finish was obtained without any regrinding—and the number of scrapped rolls fell to zero. Here's why: Vacuum-melting removes the gases which create nonmetallic inclusions in the molten metal before they get into the product. This means cleaner metal, smoother surfaces. What's more, vacuum-melting improves fatigue, creep and impact strengths . . . reduces brittleness.

Vacuum-melted metals are the answer to jobs where surface is critical—like gauge blocks, plug and ring gauges, rolls for aluminum foil—as well as many other specially demanding applications. They're available in most grades and sizes, including special ferrous and non-ferrous alloys. Write now for a free analysis sheet on which to describe your application. It will help us both decide how vacuum-melted metals can serve you best. *Vacuum Metals Corporation, Div. of Crucible Steel Company of America, P.O. Box 977, Syracuse 1, N.Y.*

VMC®

VACUUM METALS CORPORATION

Division of Crucible Steel Company of America

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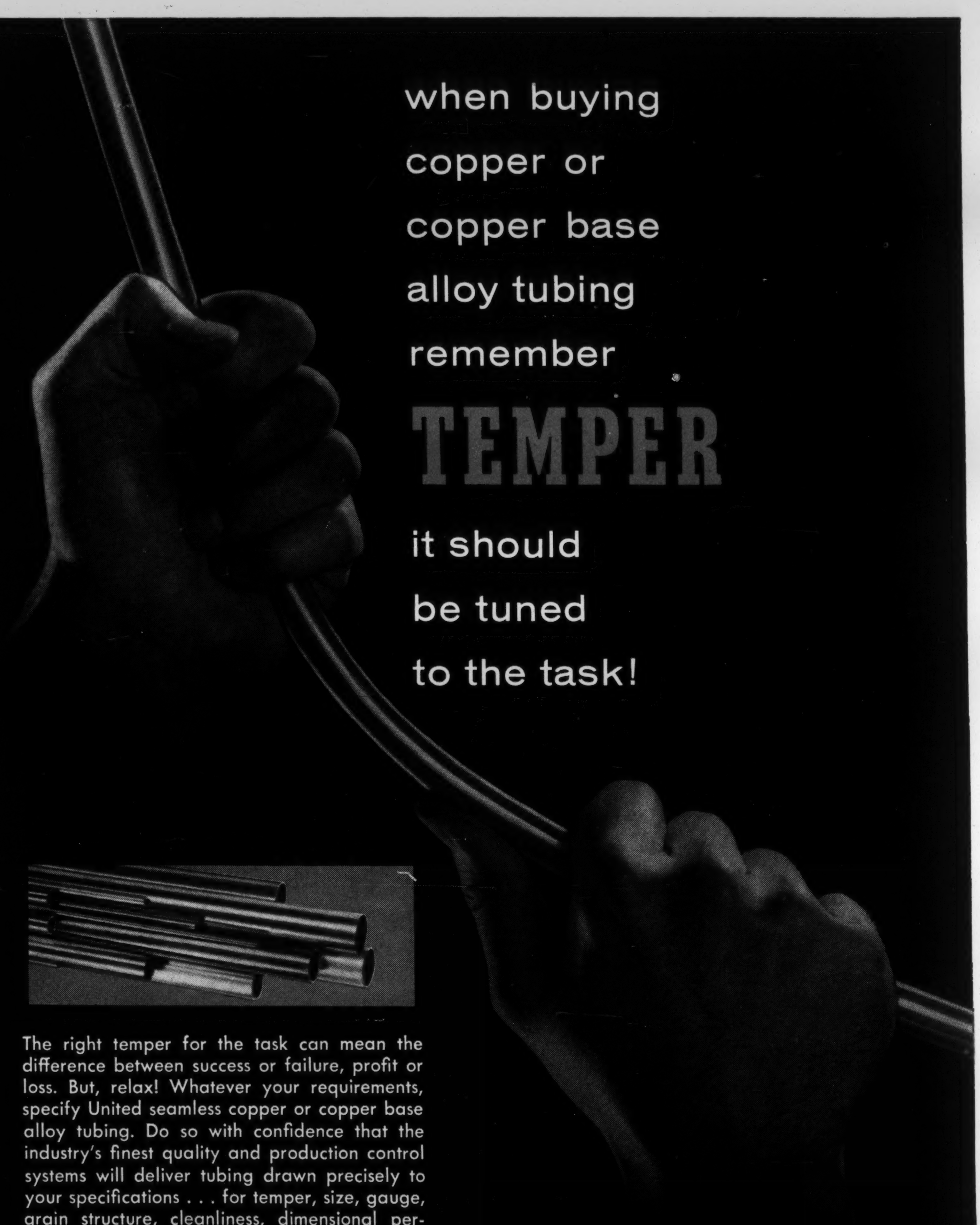


when buying
copper or
copper base
alloy tubing
remember

TEMPER

it should
be tuned
to the task!

The right temper for the task can mean the difference between success or failure, profit or loss. But, relax! Whatever your requirements, specify United seamless copper or copper base alloy tubing. Do so with confidence that the industry's finest quality and production control systems will deliver tubing drawn precisely to your specifications . . . for temper, size, gauge, grain structure, cleanliness, dimensional perfection and cost!

You pay no more for this quality! United tubing, the finest in copper and copper base alloy, is available in coils, straight mill lengths or cut to your specifications.

For full information, write or call United.

Permanently United

UNITED WIRE
AND SUPPLY CORPORATION

PROVIDENCE 7, RHODE ISLAND
COPPER, BRASS, ALUMINUM WIRE AND TUBE . . . BRAZING ALLOYS • PHOSON • SIL-BOND

For more information, turn to Reader Service Card, Circle No. 498

Roving reporter, half mile under the sea

Exploring at the bottom of a 2000-foot coaxial cable, "Project Fisheye" now roams the ocean depths collecting information for our Navy about sunken vessels, currents, and mysterious undersea life. Its findings are televised to observers on the surface.

Such information from underseas may well prove as valuable to man as the facts radioed from our man-made satellites in outer space.

Like the electronic age itself, this submarine marvel just couldn't work without the best of electrical insulations—the kind CDF is famous for . . . insulations designed and made for outstanding performance under critical conditions.

FOR SPECIFIC INFORMATION on CDF products, see Sweet's, Electronics Buyers' Guide, and other directories. Then send us your print or your problem, and we'll return free samples and technical literature.

CDF MAKES Dilecto Laminated Plastics • Celoron and Polyester-Glass Molded Plastics • Micabond Mica Products • Diamond Vulcanized Fibre • Vulcoid • Flexible Tapes of Teflon*, Silicone, and Micabond • Resin-Impregnated Spiral Tubing • *Complete Fabrication Facilities.*

*duPont trademark for its tetrafluoroethylene resin

CDF **CONTINENTAL-DIAMOND FIBRE**

A SUBSIDIARY OF THE BUDD COMPANY • NEWARK 25, DELAWARE

For more information, turn to Reader Service Card, Circle No. 389

A foursome holes out on the 4th green at Inverness. The bethanized chain-link fence was made and erected by Marleau-Hercules Fence Co., Toledo.

Inverness Club, host for USGA Open, chooses bethanized fence

Top golfers will compete for the coveted USGA Open crown on the scenic and challenging links at the Inverness Club near Toledo, Ohio. Getting ready for the tournament, to be held June 13 to 15, was a big task for the club management.

One of their first steps last fall was to enclose several long stretches of the club boundary. They wanted a fence that would be both attractive and long-lasting — two good reasons for choosing fence made from bethanized wire.

Bethanized wire is used for much of the chain-link fence sold today. Its uniform coating of pure zinc is deposited electrolytically on the steel wire. It goes on atom by atom. There are no thin spots. Long after other types of fence have become unsightly, bethanized fence stays bright because the tightly bonded jacket of zinc just won't crack or flake off.

Fence erectors like bethanized fence because the wires are smooth, with no sharp or rough spots to slash fingers. And at playgrounds and swimming pools there is no danger of torn clothing or injury when people crowd against the fence.

Bethanized wire is ideal for twisted wire brushes, conveyor belts, chain, and many other products that are severely formed. The zinc is highly ductile because in our unique process the zinc deposited is 99.9-pct-pure. We can supply this popular wire in hard or soft temper, with light or heavy zinc coatings. Our nearest sales office will gladly arrange to ship you a trial order.

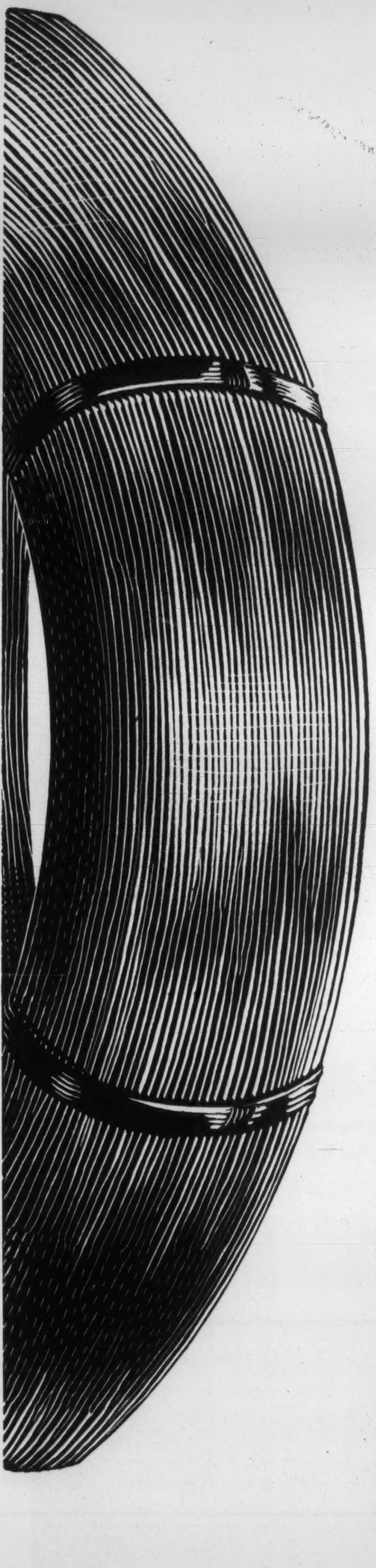
Fence made from bethanized wire stays strong and bright. Its uniform coating of electrolytic zinc is tightly bonded to the steel for long service.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.
On the Pacific Coast Bethlehem products are sold by
Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

For more information, turn to Reader Service Card, Circle No. 444



209 DIFFERENT KINDS OF WIRE

. . . and Youngstown Makes Them All

No matter what type wire you require, Youngstown should be your specification for high quality, uniformity and dependability. That's because they are all drawn from specially refined open-hearth carbon steels to meet **your** most exacting specifications.

Every grade of Youngstown Wire is rigidly quality-controlled in all steps of its production from ore mining to finish drawing and coating. This guarantees you a uniform product—both chemically and physically—that's free from injurious seams and piping, laps, die marks, as well as internal tearing and cupping.

Why not study this listing—it may suggest new products you could make from Youngstown Wire to boost both your sales volume and profits.

For additional information or metallurgical assistance, write or phone today to your nearest Youngstown District Sales Office.

QUALITY YOUNGSTOWN SERVICE

THE YOUNGSTOWN SHEET AND TUBE COMPANY
Manufacturers of Carbon, Alloy and Yoloy Steel
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- Aircraft Wire
- Alloy Wire
- Annealed Wires
- Armor Wire:
  - Armoring Wire
- Artificial Flower Wire
- Automotive Wire
- Awl Wire
- Axle Wire
- Bail Wire
- Bale Tie Wire
- Baling Wire
- Ball Pin Wire
- Basic Wire
- Basket Handle Wire
- Bed Rods
- Bessemer Spring Wire
- Bicycle Chain Stud Stock
- Bicycle Spoke Wire
- Binding Wire
- Bolt and Rivet Wire
- Bond Wire
- Bonnet Wire
- Bookbinder Wire
- Border Wire
- Bottle Handle Wire
- Bottling Wire
- Box Binding Wire
- Box Hinge Wire
- Brace Wire
- Brick Cutting Wire
- Bright Wire
- Broom Wire
- Brush Wire
- Buckle Wire
- Bundling Wire
- Button Hook Wire
- Cable Armor Wire
- Can Key Wire
- Cap Screw Wire
- Car Heater Wire
- Car Seat Wire
- Card Wire
- Cast Steel Wire
- Ceiling Hook Wire
- Chain Welding Wire
- Chain Wire
- Chair Rods
- Chair Wire
- Channel Bead Wire
- Channel Pin Wire
- Check Rower Wire
- Clasp Wire
- Clip Wire
- Clothes Line Wire
- Clothes Pin Wire
- Coat Hanger Wire
- Coat and Hat Hook Wire
- Coiled Spring Wire
- Cold Heading Wire
- Concrete Reinforcement Wire
- Copper Bearing Wire
- Coppered Wire
- Core Wire (A.C.S.R.)
- Cork Screw Wire
- Cotter Pin Wire
- Crimping Wire
- Croquet Arch Wire
- Curry Comb Wire
- Curtain Rods
- Damper Rods
- Double Clinch Wire
- Dowel Wire
- Duck Bill Nail Wire
- Eave Trough Hanger Wire
- Edge Wire
- Elevator Hoisting Cable Wire
- Fence Wire
- Ferrule Wire
- Fine size Wire
- Firing Pin Wire
- Fish and Leader Wire
- Flesh Fork Wire
- Flexible Shaft Wire
- Florist Wire
- Foundry Core Wire
- Frame Wire
- Fruit Jar Wire
- Fuse Wire
- Galvanized Wire
- Galvanized Armor Cable Wire
- Galvanized Brace Wire
- Garment Hanger Wire
- Gate Hook Wire
- Grape Tie Wire
- Grass Catcher Wire
- Guard Wire
- Gun Wrapping Wire
- Hairpin Wire
- Handle Wire
- Harness Snap Wire
- Hat and Coat Hook Wire
- Hat Rods
- Head Lining Wire
- High Carbon Wire
- Hog Ring Wire
- Hook and Eye Wire
- Hoop Wire
- Hose Binding Wire
- Husking Pin Wire
- Key Wire
- Key Ring Wire
- Key Stock
- Keystone Wire
- Lacing Wire
- Lantern Wire
- Lathing Wire
- Link Wire
- Lintel Wire
- Lock Washer
- Loop Wire
- Machinery Wire
- Machine Screw Stock
- Manufacturers' Wire
- Market Wire
- Mat Border Rods
- Mat Wire
- Mattress Wire
- Metal Stitching Wire
- Muzzle Wire
- Nail Head Wire
- Nail Wire
- Neck Wire
- Neck Yoke Ring Wire
- Netting Wire
- Nickel Steel Wire
- Non-corrosive Wire
- Nut Cracker Wire
- No-Sag Spring Wire
- Oval Wire
- Oven Rack Wire
- Pail Bail Wire
- Pail Rim Wire
- Piano Rods
- Pin Wire
- Pinion Wire
- Pivot Wire
- Pipe Winding Wire
- Plow Steel Wire
- Plunger Wire
- Pneumatic Tire Bead Wire
- Pot Chain Wire
- Poultry Netting Wire
- Pump Chain Wire
- Rake Tooth Wire
- Refrigerator Shelf Wire
- Reinforcement Wire
- Riveting Wire
- Rivet Rods
- Rivet Wire
- Rock Fastener Wire
- Roll Threading Wire
- Rope Wire
- Saddle Spring Wire
- Sash Cord Wire
- Scrapless Nut Wire
- Scratch Brush Wire
- Screen Wire
- Screw Wire
- Screw Driver Wire
- Screw Rod Wire
- Shade Roller Wire
- Shelf Wire
- Skid Chain Wire
- Smooth Wire
- Snare Wire
- Soft Processed Wire
- Spark Plug Wire
- Spiral Hooping
- Spoke Wire
- Spring Wire
- Stapling Wire
- Stitching Wire
- Stone Wire
- Stove Bolt Wire
- Stove Pipe Wire
- Stove Rods
- Straightened & Cut Wire
- Strapping Wire
- Stud Stock
- Surveyors' Chain Wire
- Tack Wire
- Tag Wire
- Tie Wire
- Tire Bead Wire
- Towel Rods
- Toy Wire
- Trap Spring Wire
- Transom Rods
- Trellis Wire
- Tuning Pin Wire
- Tying Wire
- Umbrella Wire
- Wash Boiler Wire
- Weaving Wire
- Welding Wire
- Whip Guard Wire
- Wood Screw Wire
- Wrapping Wire
- Zig Zag Spring Wire

For more information, turn to Reader Service Card, Circle No. 393

For more information, Circle No. 568 ➤

Photo courtesy Hofran Incorporated, Tampa, Fla.

Now—"Iron Mike" has met his master!

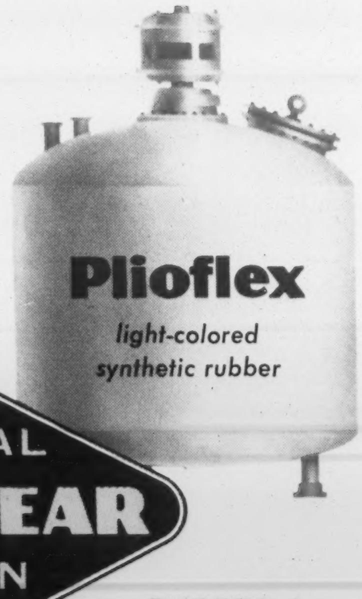
It's tough to make the starting team in the big leagues. But for a baseball, it's even tougher to qualify for batting practice. For here there's little letup in the pounding, the scuffing or the skinning. Particularly when "Iron Mike," the pitching machine, does the serving up.

A standout performer in this job – and in playgrounds, sand lots and batting ranges across the country–is an unusually durable ball with a molded-on, rubberized cord cover. This cover fully resists impact, abrasion and moisture, including repeated washing. As a result the ball retains its size, shape, weight and "grippability" much longer than its higher priced counterparts.

Much of the success of this ball lies in the use of three Goodyear materials in the cover compound. PLIOFLEX, the light-colored, oil-extended rubber, lowers both weight and cost without loss of desirable qualities. PLIOLITE S-6B – the high styrene, rubber reinforcing resin – adds toughness and a leatherlike feel. And WING-STAY S–a nonstaining antioxidant–protects the original whiteness and physical properties against age and sunlight.

Mastering "Iron Mike" is just one example of how properly compounded PLIOFLEX rubber can answer many product problems. If you would like more information on how PLIOFLEX or PLIOLITE S-6B or WING-STAY S can help your products, just write to:
Goodyear, Chemical Division, Dept. F-9437, Akron 16, Ohio.

Chemigum, Plioflex, Pliolite, Plio-Tuf, Pliovic, Wing-Stay–T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio



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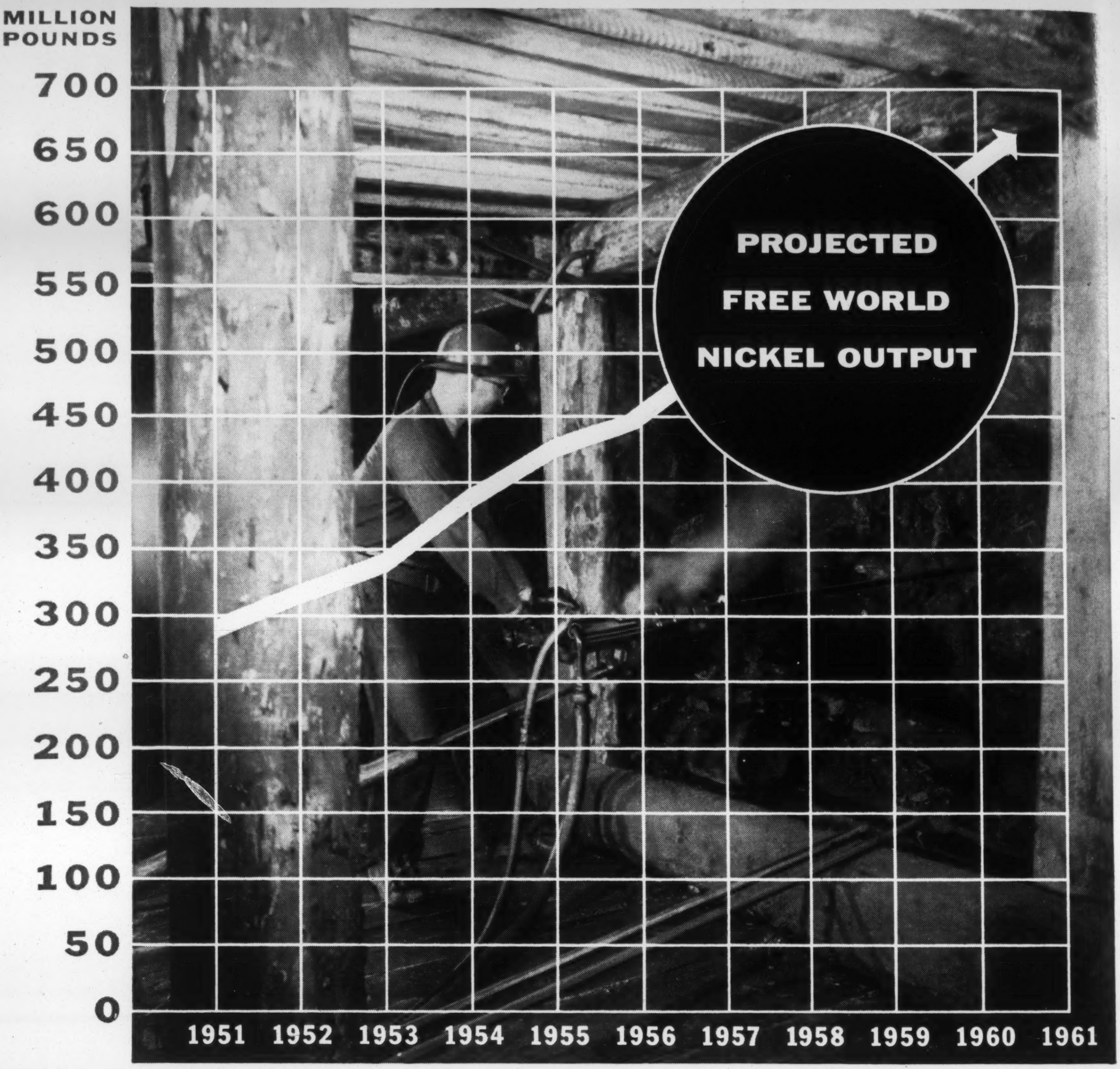
High Polymer Resins, Rubbers, Latices and Related Chemicals for the Process Industries



Another 50% advance in nickel industry's production capacity

Paced by Inco-Canada's new developments in Manitoba, producers put 1961 Free World nickel output at 650-675 million pounds a year—up 130% over 1951

In 1951, the nickel industry of the *Free World* produced about 290 million pounds of nickel.

Last year, the over-all output of the industry set a new record high of 450 million pounds.

This was an expansion of more than 50% in five years: a substantial production boost that indeed benefited industry, but only after vital defense and government stockpile needs were given preference.

New Inco-Canada developments help set new goals

Right now Inco-Canada, with years of exploration behind the project, is pushing construction at its new Manitoba mines: developing in the far North a new, big-tonnage nickel-producing area.

In Ontario, at the same time, Inco-Canada is continuing to expand its Sudbury capacity.

In 1961, this should lift Inco-Canada's nickel output to 385 million pounds a year. A hundred million more than in 1956!

With the steadily increasing capacity of all *Free World* producers, in the next four years nickel production should be lifted to the all-time high of 650-675 million pounds a year.

With 1961 capacity anticipated at more than twice what it was in 1951—and with continuing exploration—nickel users are assured of more nickel in their future.

The International Nickel Company, Inc.,
New York 5, N.Y.

© 1957, T. I. N. Co., Inc.

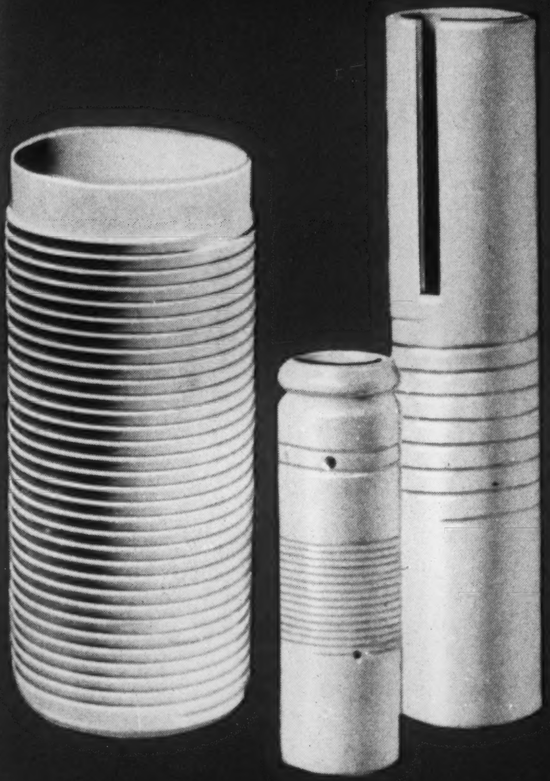
INCO **International Nickel**

The International Nickel Company, Inc., is the U. S. affiliate of The International Nickel Company of Canada, Limited (Inco-Canada)—producer of Inco Nickel, Copper, Cobalt, Iron Ore, Tellurium, Selenium and Platinum, Palladium and Other Precious Metals

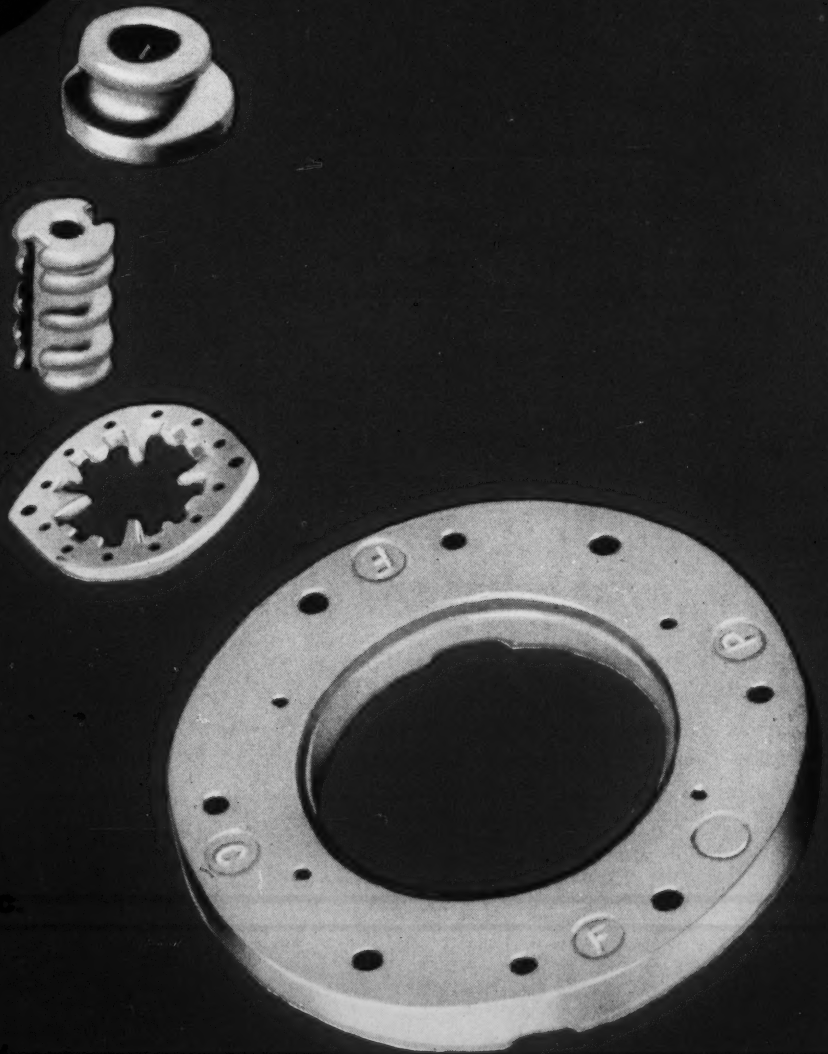
For more information, turn to Reader Service Card, Circle No. 532

Centralab 1922 1957 35 YEARS

Here's a versatile super-ceramic that shrugs off shock...heat...abrasion



Centralab High Alumina Ceramic



Centralab High Alumina ceramic can be fabricated in any shape, form, or size — to exacting tolerances — for applications requiring exceptional strength, greater shock- and heat-resistance.

In addition to its superior electrical characteristics, Centralab High Alumina ceramic is chemically inert and remains stable under radiation bombardments, elevated temperatures, and controlled atmospheres.

Centralab High Alumina ceramic is available in production quantities — in 85% and 95% unmetallized or metallized bodies.

Send your inquiry to Centralab. Our service includes competent engineering assistance by ceramics specialists, and modern facilities geared for prompt deliveries.

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One of America's largest manufacturers of engineered ceramics. Regardless of requirement, Centralab specialists and facilities can produce the High Alumina ceramic-component design you want.

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Continued on next page . . .

For high-quality vacuum-tight seals at low or high temperatures...

...specify Centralab Metallized Ceramics

Centralab offers you unmatched facilities and experience to produce fired or pressed-on metallized components for all your mechanical and electrical uses.

Steatite bodies with low-temperature seals or High Alumina components with special high-temperature alloy seals are available.

Properly matched metal-ceramic combinations facilitate brazing . . . prevent bake-out. And integrally formed metals and ceramics minimize destructive motion and vibration, maintain close tolerance, and provide excellent electrical characteristics.

Centralab offers you modern facilities and the services of ceramics specialists to help improve your product's efficiency.

Send your inquiry to Centralab today. And ask for Bulletin 42-221 showing complete facilities.

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Discuss your special requirements with your Centralab representative

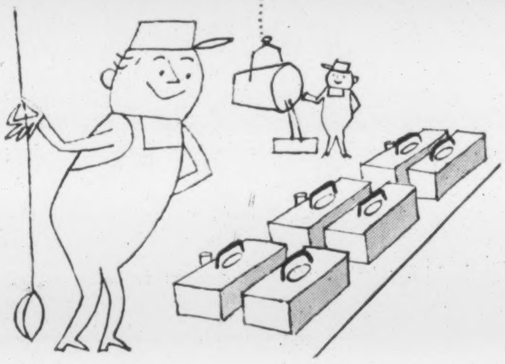
. . . Continued from preceding page

Q

Saving all you can on

Production Bronze Castings?

Here?



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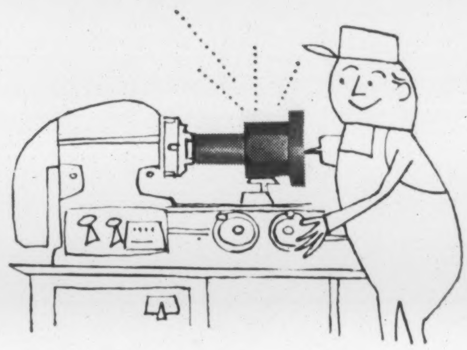
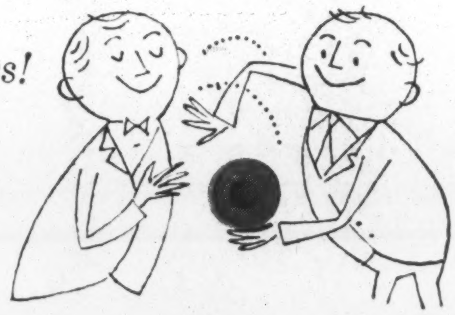


A

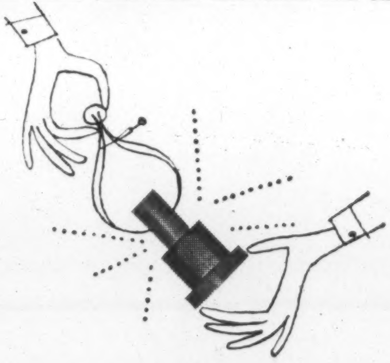
You do, with

Ampco Shell Moldings!

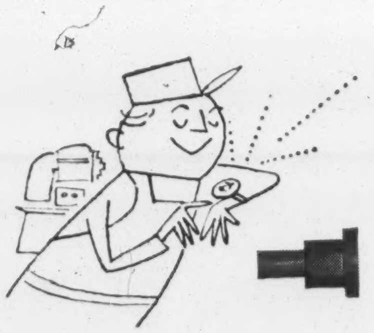
Smoother cast surfaces!
Often, smooth enough to use as is.



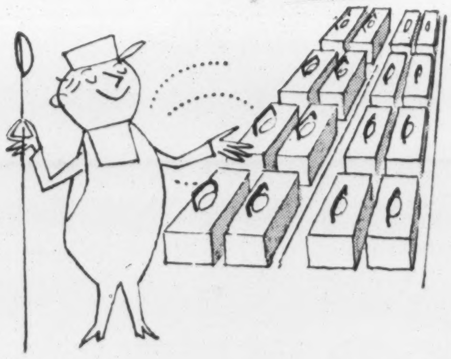
Closer tolerances!
Most castings held to ±.015 — favorable shapes, ±.010.



Less machining!
In some cases, finishing operations are eliminated.



Lower cost!
High-speed, semi-automatic mold production means foundry economy.



AMPCO®

THE METAL WITHOUT AN EQUAL

AMPCO METAL, INC.
Milwaukee 46, Wisconsin
West Coast Plant:
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One-source service from raw material to finished product

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AMPCO METAL, INC.
Dept. MA-6, Milwaukee 46, Wisconsin
Send me Bulletin G-36 on shell moldings; also information on other Ampco products I have checked.

Name...

Title...

Company...

Address...

City.......................... Zone.......... State..........................

- ☐ Specifications of Ampco Metal
- ☐ Ampco Wrought Products
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D-61

◂ For more information, Circle No. 560

For more information, turn to Reader Service Card, Circle No. 473

HERE'S THE TEST . . .

Difficult forming operations like these are successfully met with Wallace Barnes high carbon strip steels. Stack 'em up against *your* part or product . . . These finest steels will convince you of their all-around performance and workability. Let us help you select the right type for your requirement.

Blanked on 45° An

All Flanging One Operation

Thirteen Steps Progressive

Three Drawing Stations

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ASSOCIATED SPRING CORPORATION

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DIVISIONS OF ASSOCIATED SPRING CORPORATION
COAST TO COAST

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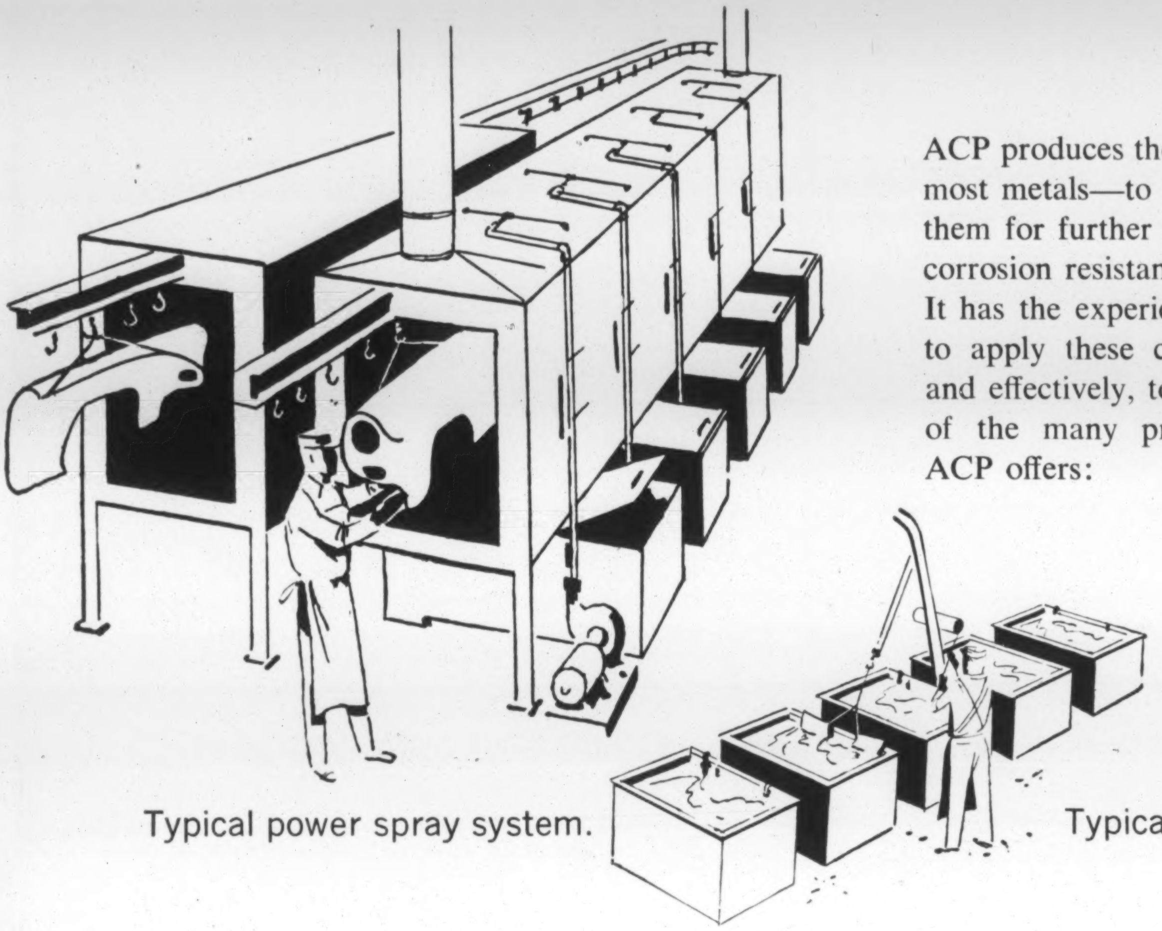
Treat Metals Fast and Economically with ACP Chemicals and Processes

ACP produces the chemicals for treating most metals—to clean them, to prepare them for further processing, to improve corrosion resistance and paint adhesion. It has the experience and the personnel to apply these chemicals economically and effectively, too. Here are just a few of the many products and processes ACP offers:



Typical power spray system. Typical immersion system.

ACP GRANODINE®—a phosphate coating process for steel which provides an excellent bond for paint and greatly improves the corrosion resistance of the paint system.

ACP ALODINE®—an amorphous coating process for aluminum which protects both painted and unpainted metal and anchors the paint finish.

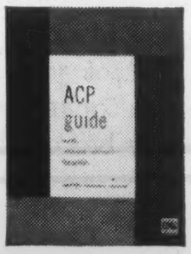
ACP LITHOFORM®—a phosphate or chromate coating process which prevents objectionable chemical reaction between metal and paint, keeps paint on zinc and cadmium surfaces.

ACP DEOXIDINE®—a phosphoric acid metal cleaner which removes rust and organic soils, destroys rusters, prepares steel, aluminum, brass, copper and other metals for painting.

ACP METAL CLEANERS—Ridoline,® alkaline metal cleaner and Ridosol,® solvent-detergent metal cleaner—remove metal preservatives and metal working lubricants from metals in process.

ACP RODINE®—pickling acid inhibitors which reduce acid consumption, save steel. They also minimize pitting, burning and embrittlement and reduce the formation of acid fumes.

Write for the "ACP GUIDE to the chemical treatment of metals."



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ACP
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New Chemical Horizons for Industry and Agriculture

◀ For more information, Circle No. 540

For more information, turn to Reader Service Card, Circle No. 507

QUALITY CONTROL REPORT

These sparks reveal vital facts about quality control of steel

You are naturally interested in the quality of your finished products—and if you use steel in making them, you should know about the Ryerson quality controls symbolized by this spark test.

Here a skilled Ryerson inspector is checking the carbon content of a steel bar by "reading" the sparks thrown off by an abrasive wheel. It's an amazingly accurate method of making sure that you get exactly the steel you order.

And this is only one of many rigid quality controls that protect you in every purchase of steel from Ryerson stocks. For example, a heat symbol identifies every bar of alloy steel to avoid the problem of variation from heat to heat. Another example: cylinder tubing can be furnished to more accurate inside diameter through Ryerson specs controlling O. D. and I. D. instead of O. D. and wall.

The result: steel of certified quality—assured by exacting Ryerson controls, whether your product calls for carbon, alloy or stainless steels. And these quality controls become *your* quality controls in your finished product.

These are important points to remember when you specify or purchase steel. You get extra value every time you order from your nearby Ryerson plant.

RYERSON STEEL

In stock: Carbon, alloy and stainless steel—bars, structurals, plates, sheets, tubing, industrial plastics, machinery & tools, etc.

JOSEPH T. RYERSON & SON, INC. PLANTS AT: NEW YORK • BOSTON • WALLINGFORD, CONN. • PHILADELPHIA • CHARLOTTE • CINCINNATI
CLEVELAND • DETROIT • PITTSBURGH • BUFFALO • CHICAGO • MILWAUKEE • ST. LOUIS • LOS ANGELES • SAN FRANCISCO • SPOKANE • SEATTLE

For more information, turn to Reader Service Card, Circle No. 497

DOW CORNING
CORPORATION

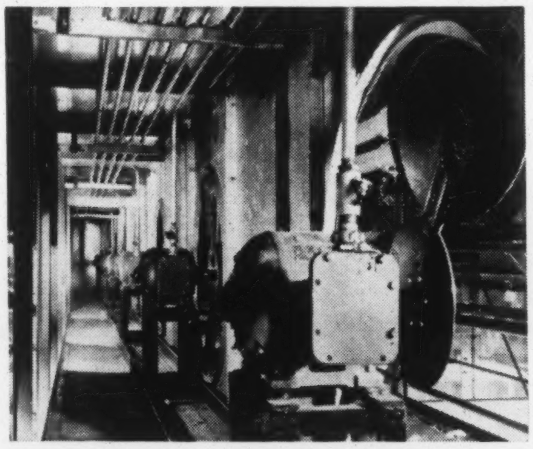
Silicone News

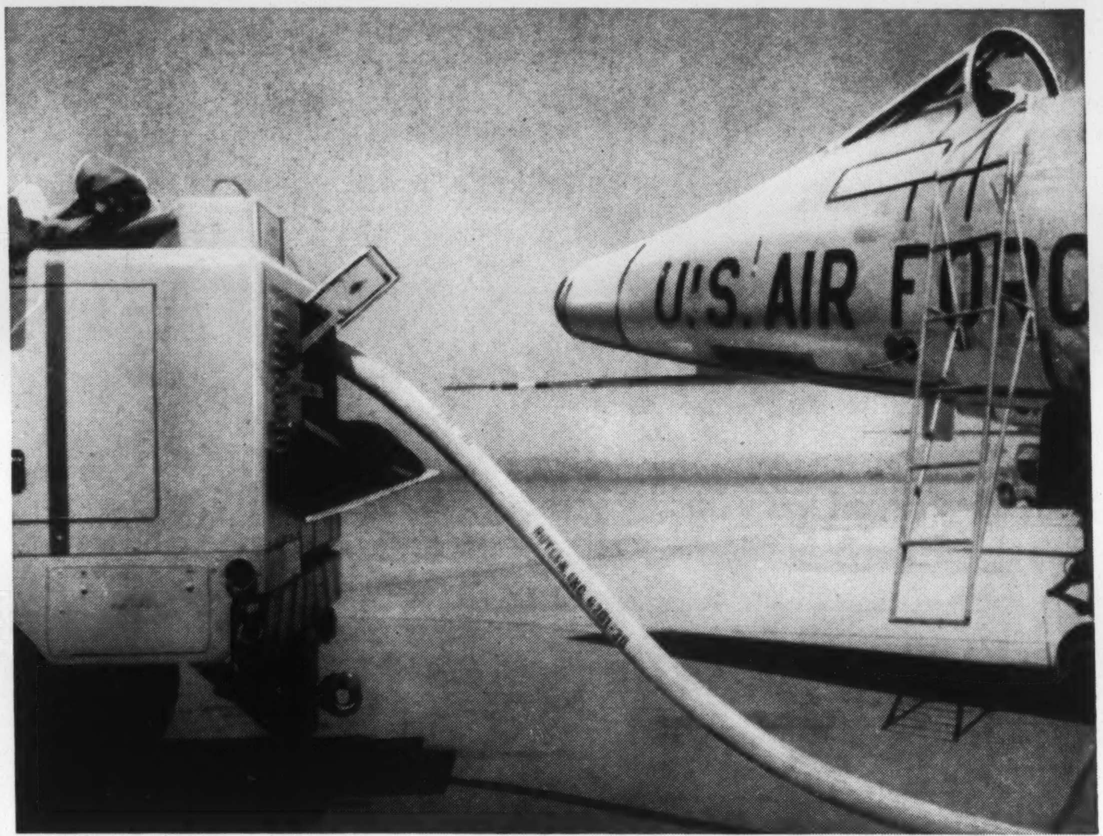
FOR DESIGN ENGINEERS No. 39

Silicone Insulated Motors Provide Dependable Service in Oven Heat

Even the hot, humid, acid atmosphere of a lumber drying kiln won't ruin fan motors insulated with Dow Corning Silicones. Just how tough conditions are for a motor inside a kiln is revealed by Standard Dry Kiln Company, Indianapolis, Indiana.

Not only must Standard's fan motors operate 24 hours a day in ambient temperatures ranging from 200 to 220 F, but they must be able to withstand relative humidity up to 100% and acid atmospheres. No wonder Standard engineers have always been quick to adopt new improvements in motor insulation, and standardized completely on Dow Corning silicone insulation for all Louis Allis fan motors in 1952. *(Cont. Pg. 2)*





SILASTIC HOSE CARRIES "FURNACE HOT" AIR TO START AIRCRAFT JET ENGINES

Most designers know that jet engines are started by hot air from portable generators. But have you ever given thought to the resilient hose or ducting used to carry the "furnace hot" air from the generator to the engine?

The combination of heat, pressure and rough usage quickly ruins even the strongest metal and fabric hoses. But that's not the case with a new silicone rubber-polyester fiber hose developed by Quaker Rubber of Philadelphia.

Light, tough and flexible, the Quaker hose easily meets rugged service requirements.

TYPICAL PROPERTIES OF SILASTIC FOR HOSE, DUCTS AND TUBING

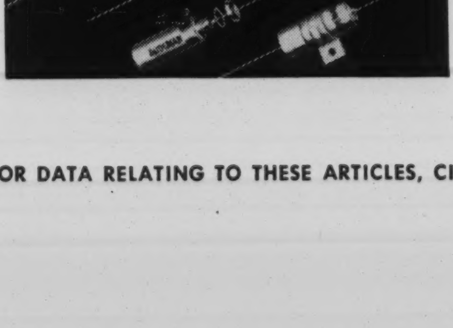
- Temperature range, °F ------- —130 to 500
- Corrosion ---------- Non-corrosive to metal
- Pressure range --------------- Low pressure
- Oil resistance ----- Dependent on type of oil
- Light Weight • Weather resistant • Flexible

For example, in recent wear tests a typical production hose withstood 65 psi pressure while conveying 125 pounds of 425 F air per minute for 200 hours on a schedule of three hours on and one hour off. The same hose was coiled and uncoiled 300 times at —65 F, then dragged six miles over concrete, macadam and dirt without noticeable wear! *(Cont. Pg. 2)*

BOOST INSULATION RESISTANCE WITH SILICONE FLUID

Because Dow Corning 200 silicone fluid has better electrical resistance than wax at elevated temperatures, many designers specify this high temperature liquid dielectric to increase the life and reliability of capacitors, small transformers and many other electronic assemblies.

Gudeman Company of Chicago, for example, impregnate their special line of miniature tubular paper capacitors for filter, bypass and blocking service with Dow Corning 200 Fluid.



Only about half as big as comparable conventional units, these silicone-impregnated capacitors are designed to meet all the electrical and environmental requirements for Characteristic "K", MIL-C-25A.

While the insulation resistance of comparable wax-impregnated capacitors at 85 C (185 F) is only about 15 megohm-microfarads, the new silicone fluid impregnated units register 150 megohm-microfarads at the same temperature. That's approximately 10 times the insulating efficiency of conventional units. ***No. 396***

FOR DATA RELATING TO THESE ARTICLES, CIRCLE REFERENCE NUMBER IN COUPON ON NEXT PAGE

MORE ☛

DOW CORNING
CORPORATION

Silicone News

DOW CORNING PUBLICATIONS ON NEW DEVELOPMENTS AND TECHNICAL DATA . . . .

Silicone Notes

Silastic — in mechanical applications — increases life and serviceability of original equipment; reduces maintenance and downtime. A completely new brochure gives properties and cites applications and case histories to help you use this versatile silicone rubber to best advantage in your application. *No. 400*

◆

Solventless Silicone Impregnating Resins now commercially available for electrical and electronic equipment, are free-flowing, can be blended, and have good pot life. On curing, these silicone encapsulating resins set to a solid mass having good electrical and physical properties; and retain such properties that a service life of 10 years at 400 F is indicated. *No. 401*

◆

Silastic 916, the first silicone rubber available that combines high strength with thermal stability, is serviceable from —130 to 500 F, has good electrical properties, and is easy to compound and process. *No. 402*

◆

Silicone Coatings for Paper impart excellent, long lasting release characteristics. Applicable as single or two side coatings to glassine, parchment and kraft, they effectively release such sticky materials as asphalt, raw rubbers, epoxy resins and polyurethane foams even after long time contact. Silicone coated papers are useful in wrapping, and interleaving and in making multi-wall bags, cartons and drums. *No. 403*

◆

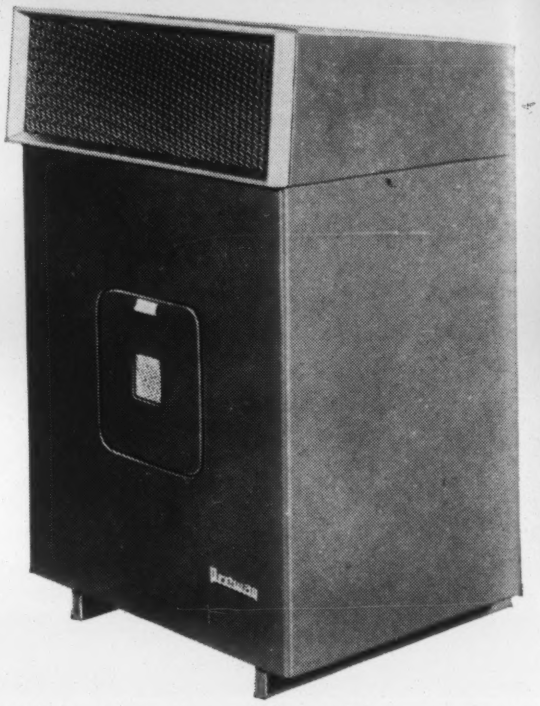
"Rubber From Rock," a new color-sound movie, explains how Silastic, the Dow Corning silicone rubber, is manufactured from quartzite. Demonstrates why parts fabricated from Silastic retain rubber-like properties from —130 to over 500 F in a wide variety of military and industrial applications. Also covers uses for Silastic as a dielectric in electronic and electrical equipment. To arrange for a showing of "Rubber From Rock" in your plant, circle .... *No. 404*

◆

1957 Guide to Dow Corning Silicones is a twelve page, fact-filled reference describing the silicone products of interest to most industries. Containing latest data and information, the new 1957 Guide is designed expressly to help you enjoy the advantages, profits, and savings made possible through imaginative use of these versatile engineering materials. *No. 405*

FOR LASTING BEAUTY AND MAXIMUM PROTECTION AT LOWEST COST . . . USE SILICONE BASED PAINT

In addition to providing Preway, Inc. of Wisconsin Rapids with a permanently attractive finish for their new line of space heaters, a silicone based paint has solved what could have been a costly design and production problem. Here's how:



When tests on the new Preway heater design revealed that the upper grill often attained a surface temperature of 550 F, it was evident that if coated with an organic finish the grille would have to be raised and the cabinet made larger. Instead of re-designing the cabinet, however, Preway engineers simply switched to a heat and oxidation-resistant silicone paint . . . and the problem was solved.

The silicone finish proved far more durable, as attractive as a conventional enamel and it saved the company the cost of expensive retooling. Furthermore, by keeping the unit compact the silicone finish has helped hold production costs down while saving floor space for the consumer without sacrificing heat output.

Preway also realizes another substantial saving on each unit by applying a silicone-aluminum coating to both sides of the drum-like "heat economizer" inside the heater. By raising the "scaling" temperature of mild steel from 1225 F to 1325 F, the silicone coating permits the use of mild steel in place of stainless . . . an additional saving of $1.59 per unit.

Both of the silicone paints in this application are "Sicon" finishes formulated with Dow Corning Silicones by Midland Industrial Finishes. *No. 397*

SILICONE INSULATED MOTORS *(Cont.)*

By switching to Dow Corning 44 Grease, Standard has also reduced its relubrication schedule for bearings in these motors from once every three months to once every three years.

Still another reduction in costs has been obtained by installing aluminum sheathed motor lead wire covered with Silastic*, the Dow Corning silicone rubber. Not only has the Silastic-insulated cable proved more dependable and maintenance-free than conventional cable, but it costs much less to install and eliminates the need for conduit and fittings.

How does Standard sum up its experience with Dow Corning Silicones after five years? According to J. B. Welch, President, "our experience indicates these motors and their wiring will operate inside the kiln day and night, year 'round without fail." *No. 398*

"HOT AIR" HOSE *(Cont.)*

This rugged new hose is comprised of two inner layers of Silastic*, the Dow Corning silicone rubber, covered with closely woven Dacron. Already a standard accessory for the portable jet "starters," it is now being considered for the hot-air ductwork to operate entire aircraft accessory systems by pneumatics. *No. 399*

*T.M. REG. U.S. PAT. OFF.

Dow Corning Corporation, Dept. 7018, Midland, Michigan

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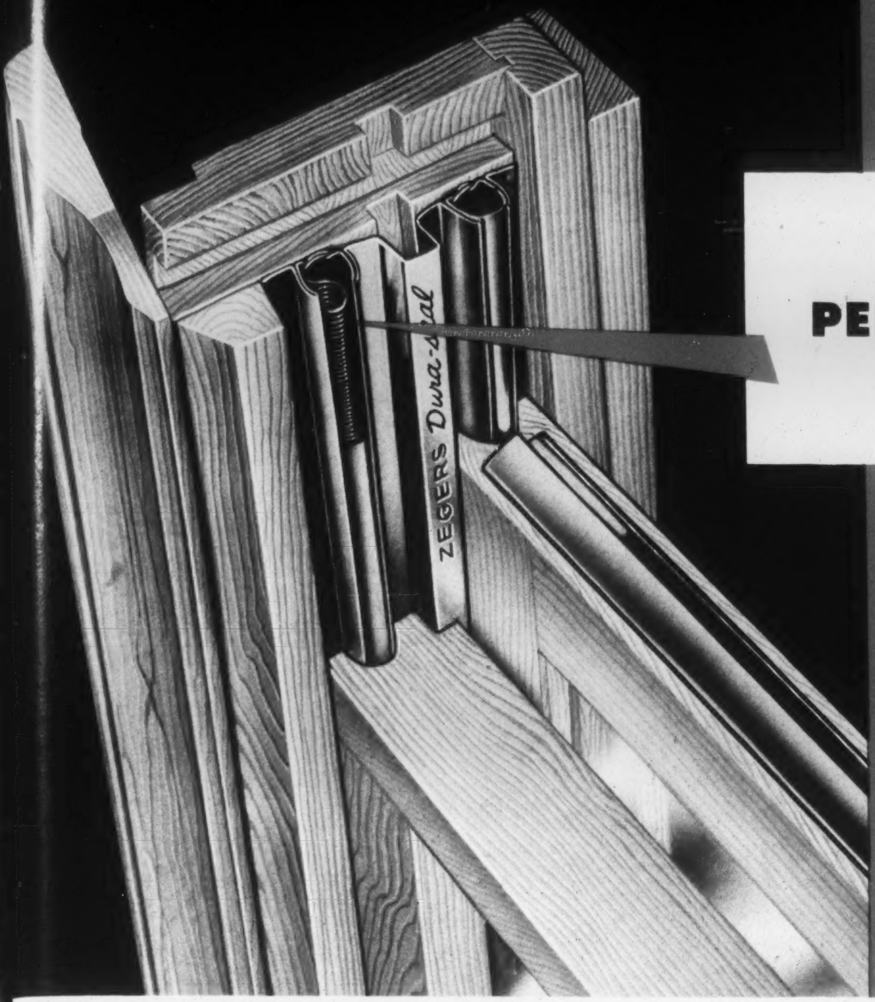
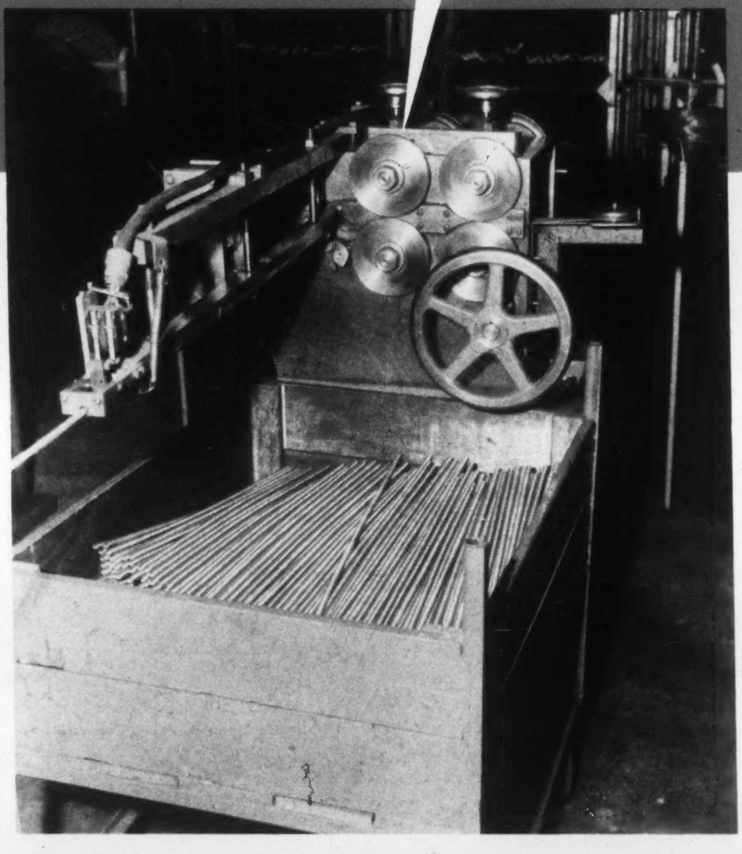


GOOD PERFORMANCE HERE

KEYSTONE WIRE STUDY

GALVANIZED MB SPRING

BEGINS HERE



Hour after hour, quality springs pop out of this spring machine. The uniformity of Keystone's drawn Galvanized MB Spring Wire assures long, trouble-free runs.

...that's why Zegers, Inc. specify KEYSTONE GALVANIZED SPRING WIRE

The above illustration shows a double hung window equipped with Dura-Seal combination metal weatherstrip and spring sash balance manufactured by Zegers, Inc., Chicago, Ill. Heart of the successful operation of this quality product is its spring balance. Not only must it have exactly the right tension for easy window operation, but must withstand countless flexings over a long period of time. Equally important, it must be easy and economical to produce.

Keystone Galvanized MB Spring Wire is preferred at Zegers for these reasons: Keystone has more consistent uniformity of composition, tensile and diameter—hence less trouble in their spring machines. That's because Keystone's unique method of cold drawing after galvanizing produces a dense, smooth coating free from flaking.

If you use wire to make your products, it will pay you to talk over your needs with your Keystone representative. For more information, send us the coupon below. Tell us how we can serve you.

Keystone Steel & Wire Company, Peoria 7, Illinois

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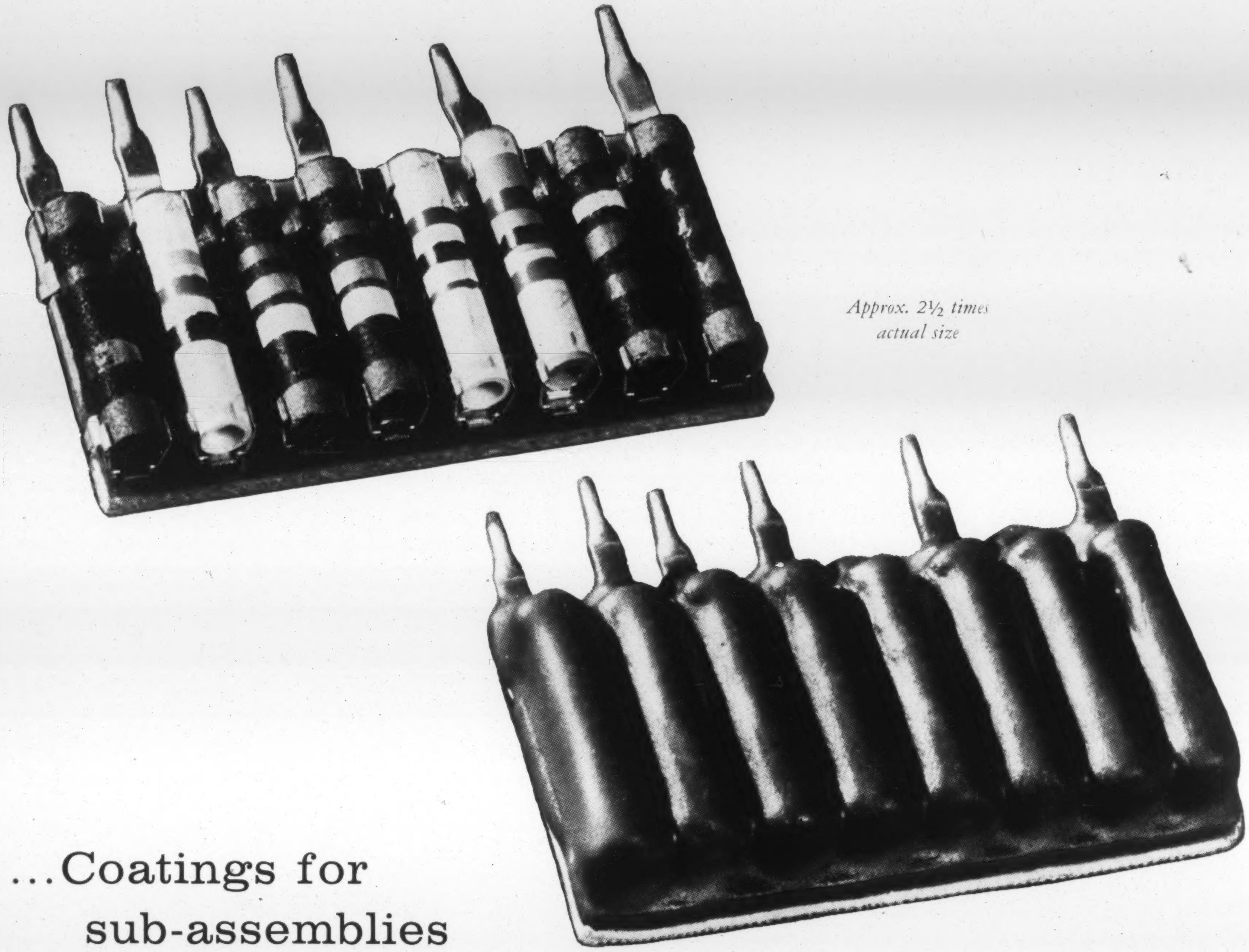
wrapping up a problem in electronics



Approx. 2½ times actual size

...Coatings for sub-assemblies suggest **other** jobs for **DUREZ** phenolic **RESINS**

IF YOU ARE FACED with a situation requiring exceptional properties in a bonding, impregnating, or coating agent, consider what Erie Resistor Corp. accomplished when it turned to Durez resins for its Pre-Assembled Components.

DEVELOPED TO EFFECT major cost reductions for electronic equipment manufacturers, these Erie "PAC" circuits combine capacitors and resistors in unitized packages for quick installation in a printed circuit board. Complete flexibility of design is offered in modules combining up to 90 components in one "package."

INSULATING PROPERTIES, mechanical strength, and heat resistance of Durez thermosetting phenolic are key factors in the protective dip-coating applied to "PAC" units. With Durez, Erie meets its own requirements that no migration or peel-back of insulating material occur when a soldering gun is applied. In the dip compound the resin produces a material that is free from running or sagging. The slight porosity of Durez allows Erie's protective wax coating to penetrate to a depth that insures complete insulation, and it cures to a hardness that permits stamping or color coding.

Can the remarkable properties of Durez thermosetting phenolic resins solve a problem for you? Whether thermal, electrical, or mechanical characteristics come first in the application you may have in mind, why not look into Durez now? Feel free to call on our long experience with these materials.

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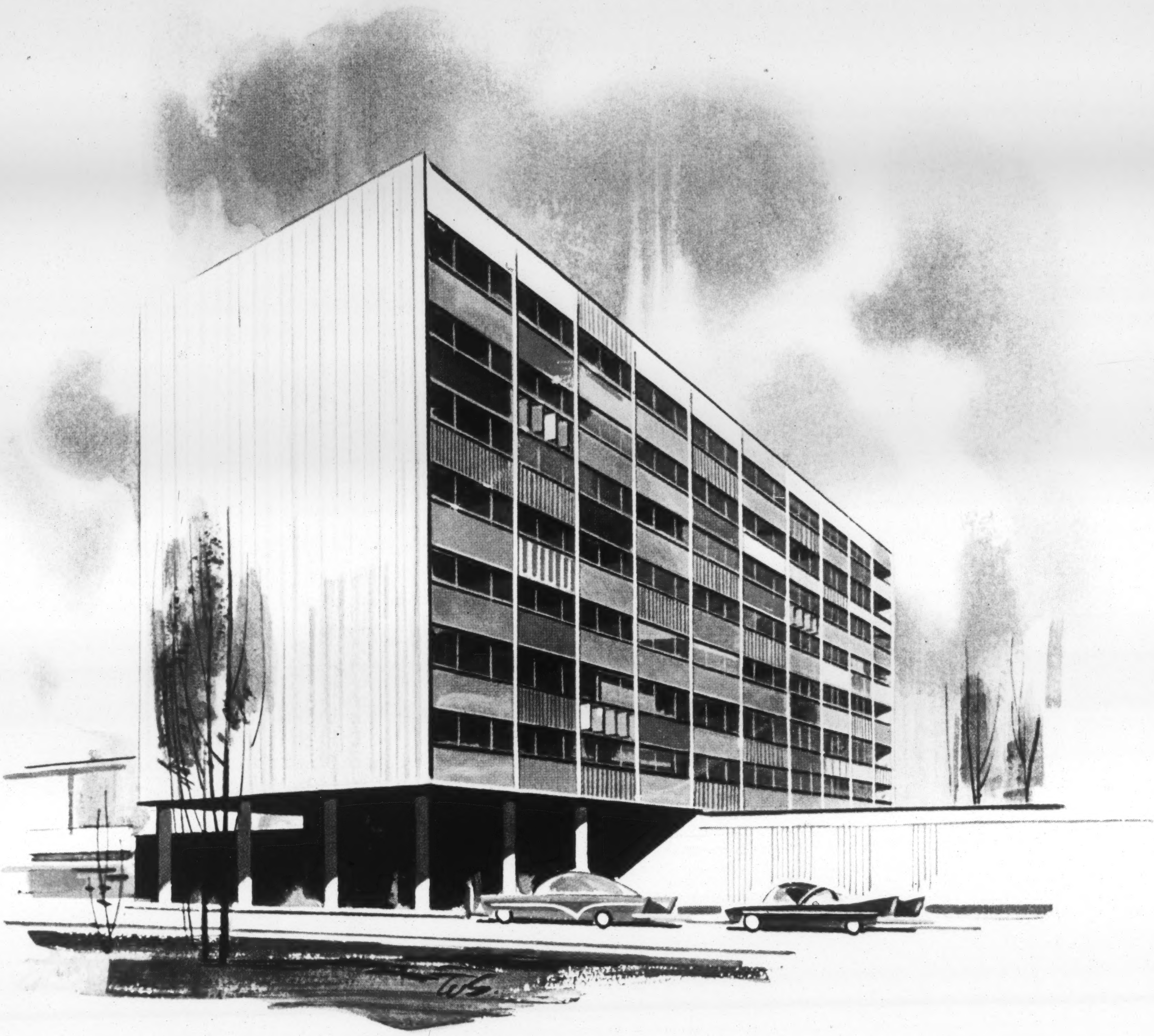

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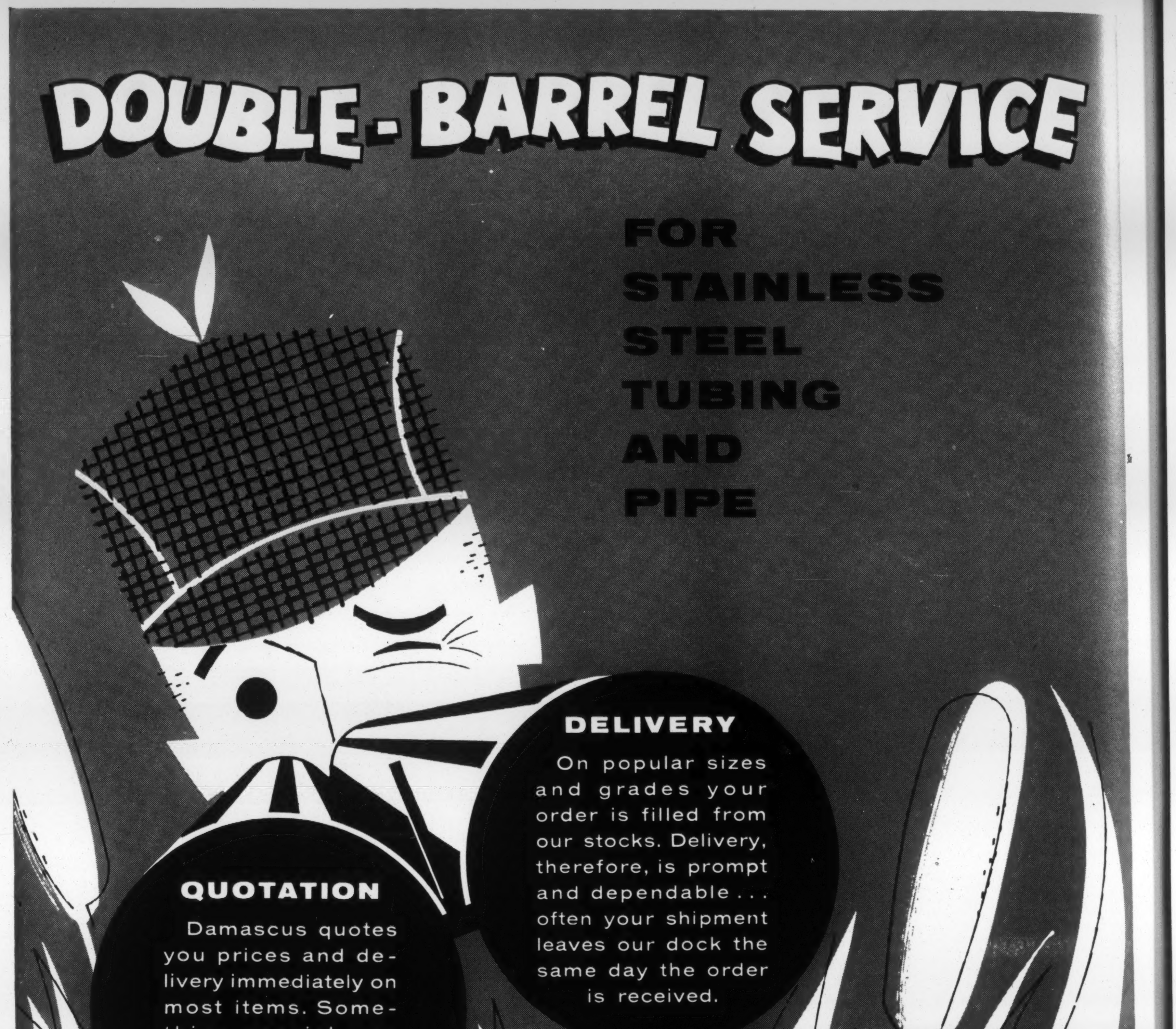

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Introducing...
the Kodak Contour Projector, Model 14-6, with Measuring Table

- **Makes fixturing easier and setups faster with table cross travel of 3″; vertical travel of 2⅛″. Focusing travel is 1½″.**
- **Provides rapid horizontal measurement to the order of .0002″ for toolroom as well as production use. Simplifies gaging of larger parts—less need to reposition.**
- **Slotted worktable—19¼″ x 8″—permits use of standard fixtures for staging wide variety of parts. Throat clearance is 14¼″. Maximum lens height above table, 4¼″; minimum, 2⅛″.**

THE Model 14-6 is equipped with the same high-quality, precision optical system as all other Kodak Contour Projectors. Kodak's famed Ektar Projection Lenses and rigidly built lens mounts and housings insure accurate performance year after year. A full 14-inch viewing screen covers a field of 1.4″ at 10× magnification. Coated lenses which increase light transmission—plus a special Fresnel lens back of the screen—give a bright image, permitting you to use the Model 14-6 anywhere in the plant. Accessory projection lenses provide a choice of six magnifications (10×, 20×, 31¼×, 50×, 62½×, and 100×). All lenses are quickly interchangeable, seat positively for precise rated magnification. Air-cooled lamphouse and simple, handy controls assure operator ease and comfort.

Vertical illuminator, surface illuminator, six-lens turret, rotating screen with protractor ring, and a mobile base are available as accessories. For further information about the new Kodak Contour Projector, Model 14-6, write to:

Apparatus and Optical Division

EASTMAN KODAK COMPANY • Rochester 4, N. Y.

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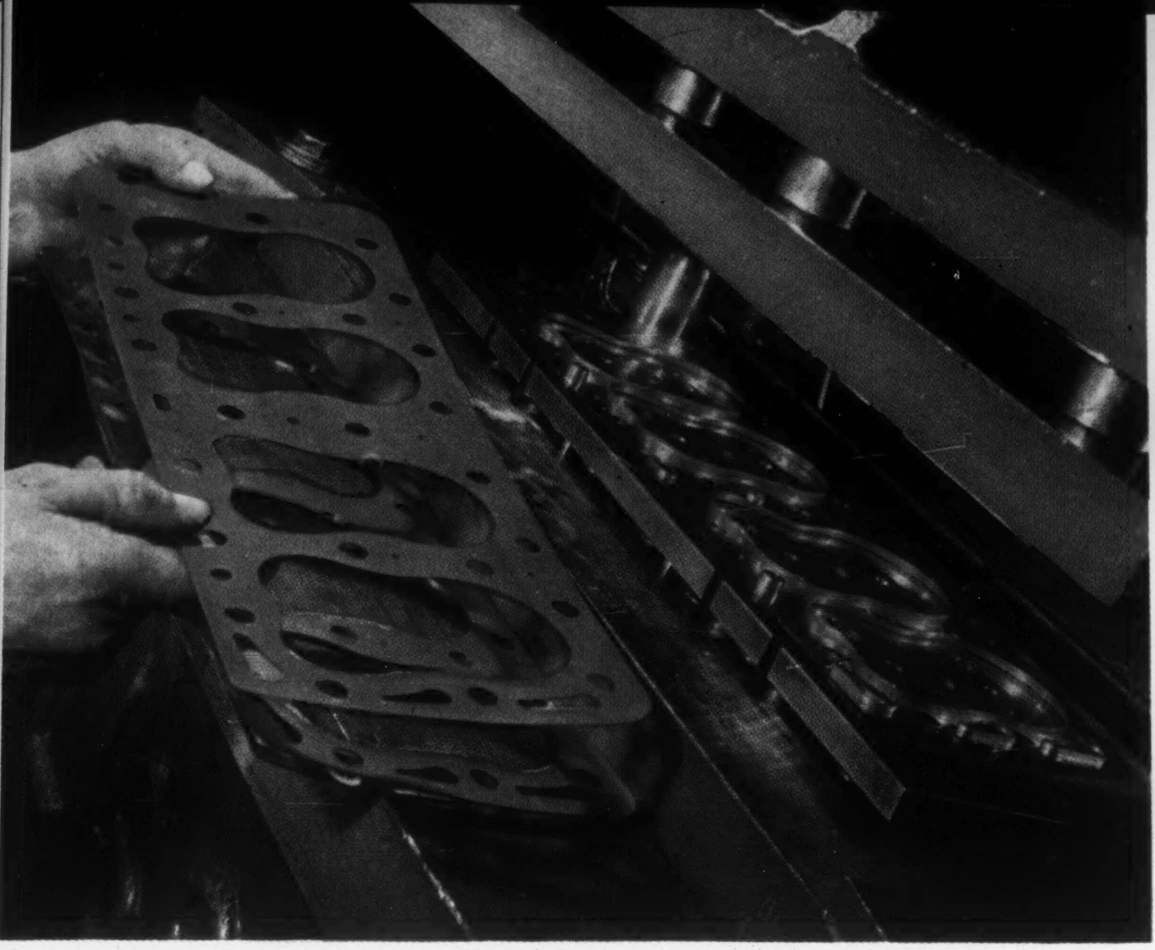
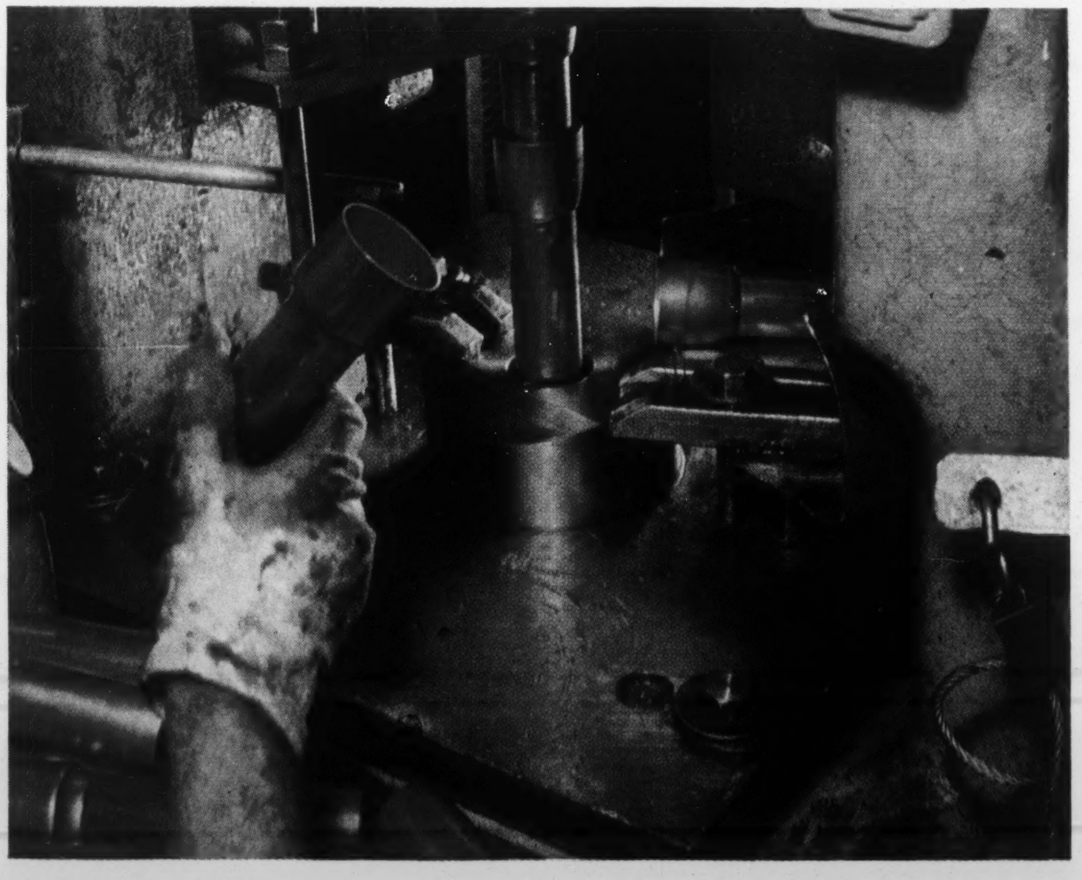


Steel's Strength, Copper's Fluidity (sealing ability) and corrosion resistance all are combined in Sterling Automotive Mfg. Co.'s use of Thomas copper-coated steel strip. By lubricating dies during punch press forming, copper coating boosted die life by 33%. The Chicago company turned to Thomas electro-coated strip to give its auto head gaskets extra strength needed for today's high-compression engines.

20 Million Shoe Horns a Year are made in Crawfordsville, Ind., plant of Steel Industries, Inc., where Thomas Strip saves up to 40% of production cost. From nickel-coated Thomas Strip, shoe horns get bright, shiny finish with only ball-burnishing after forming.

New Ways To Cut Costs With Thomas Strip

How Six Manufacturers Use These Production Ideas For Better Products



Ray-O-Vac Company saves $100,000 a year at its Clinton, Mass., Flashlight Division, by using Thomas copper-coated strip for flashlight cases. Compared to brass, Thomas deep-drawing strip is fabricated faster, requires less processing — also, copper coating lubricates dies and provides good chrome-plating base.

Manufacturers pictured on these pages chose Thomas Strip because it cuts costs, improves products—gives them higher profits and increased sales.

Pre-coated Thomas Strip is furnished ready for use with electroplated coatings of zinc, copper, brass, nickel, or chrome . . . or hot dip coated with lead alloy or tin . . . and coated with clear or colored lacquer.

Uncoated Thomas Strip products include low carbon, alloy and high carbon spring steel grades. All are available in a wide range of sizes, gages, tempers and finishes.

You also can get cold rolled Thomas Strip plain or coated with a rolled-in pattern design of your choice.

All Thomas Strip products can save you money and enhance your product in six important ways:

- **Fabricates Easily**—coated steels stand fully as much fabrication as uncoated strip.

Increased Saleability and Profits followed Pioneer Can Co.'s switch from lithographed tin plate to brass-coated Thomas Strip with a rolled-in pattern design. Pioneer's waste baskets and deco-ative cans gained in durability, beauty and re-use value. They command a higher price now and return more profits.

General Electric's styling of its deluxe range made at Appliance Park calls for liberal use of pattern-rolled Thomas Strip. Deeply rolled rib design, satin chrome-coated, is used on oven door—adds distinctive modern touch to GE's Keyboard Ranges. Thomas offers many design patterns in plain or coated steels.

- **Longer Die Life**—most coatings ubricate dies, reduce wear and in-rease tool life.
- **Maximum Pieces Per Pound**—recision rolling to extremely close ize tolerances gives more square eet of strip per ton.
- **Lower Plating Costs**—coatings an serve as final product finish or s base for further plating or paint-ng.
- **Speeds Fabrication**—Thomas trip coatings eliminate costly in-ermediate fabricating steps such as leaning, buffing, even plating.
- **Steel's Strength and Economy**—are combined with beauty and tility of more expensive metals.

All the savings and benefits Thomas Strip specialties are giving o fabricators shown here are avail-ble to you. A national sales staff—amilar with design and fabrication dvantages of Thomas Strip is ready o serve you.

Write for samples, and additional ases of users' actual experiences with Thomas Strip Products. Do it oday.

Stack 'n Add is another new product of Quaker Industries, Kenosha, Wisc. The smart sectional shelving gets strength, beauty and economy through use of Thomas brass-coated, buffed and lacquered strip for upright supports. Electro-coated Thomas Strip eliminates expensive pre-forming preparation, as well as costly plating.

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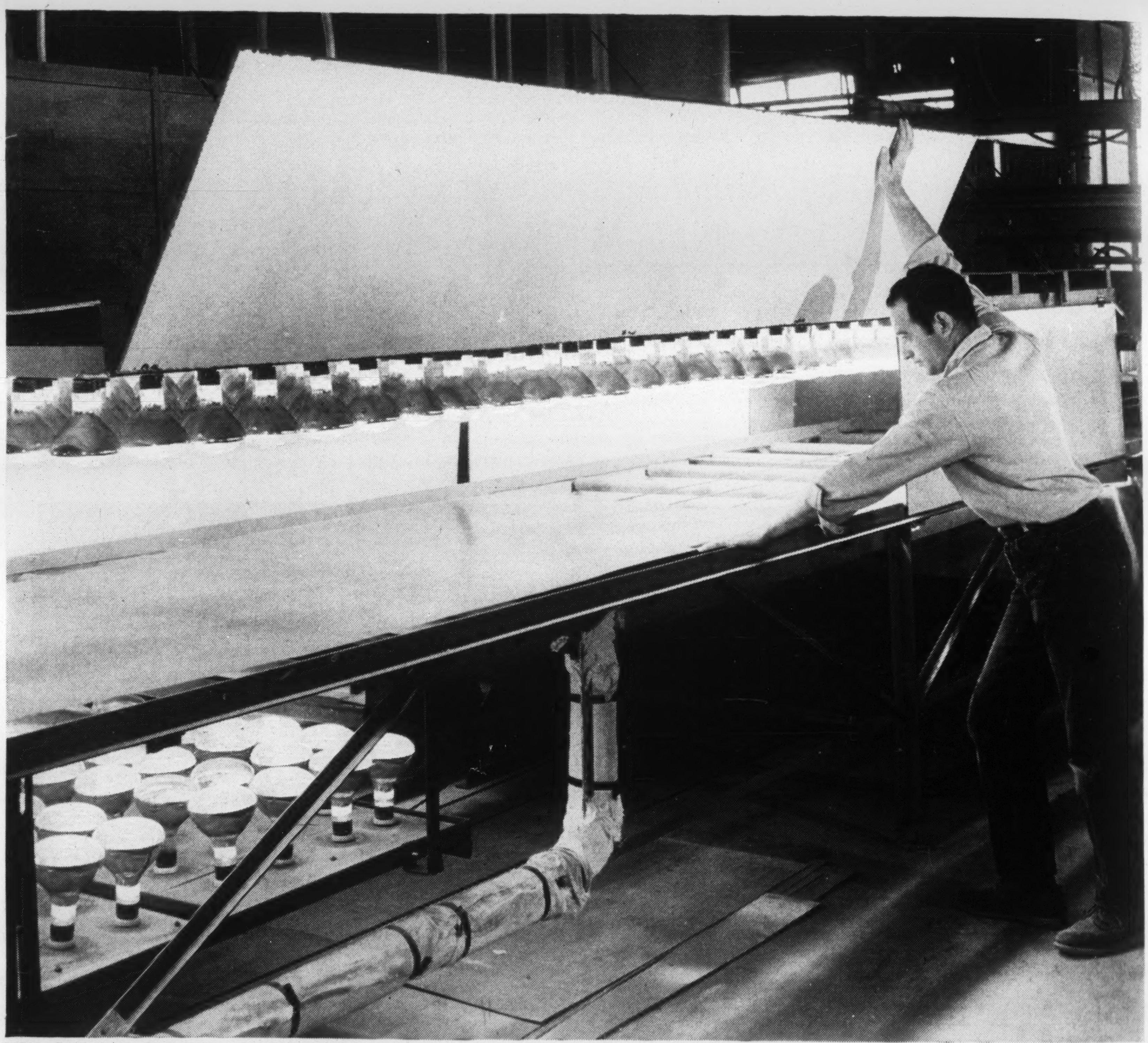
Speed high-strength sandwich bonding by predrying 3M adhesive EC-1357



YOU CAN DRY OUT THE SOLVENT BEFORE BONDING—AND GET MAXIMUM IMMEDIATE STRENGTH FAST—WITH 3M ADHESIVE EC-1357.

Here's new speed in making light, rugged sandwich panels for non-load-bearing uses!

It's EC-1357. This specially formulated, fast adhesive from the laboratories of 3M gives you high bond strength *immediately!* With infrared ovens, you can dry the solvent out of EC-1357 before bonding. Heat absorption is fast, due to EC-1357's dark color. You eliminate unnecessary drying and storage time. You need no clamps or heated presses, just cold press or nip roller. What's more, this cold bond continues to cure at room temperatures—gains added strength with age.

On metal or paper honeycomb cores, EC-1357 builds up a fillet for bigger bonding area and strength. Use EC-1357 with glass foam cores, too.

SEE WHAT 3M ADHESIVES CAN DO FOR YOU! Consult 3M Research, contact your 3M Field Engineer or write on your company letterhead for information and free literature to: 3M, Dept. 86, 417 Piquette Ave., Detroit 2, Mich.

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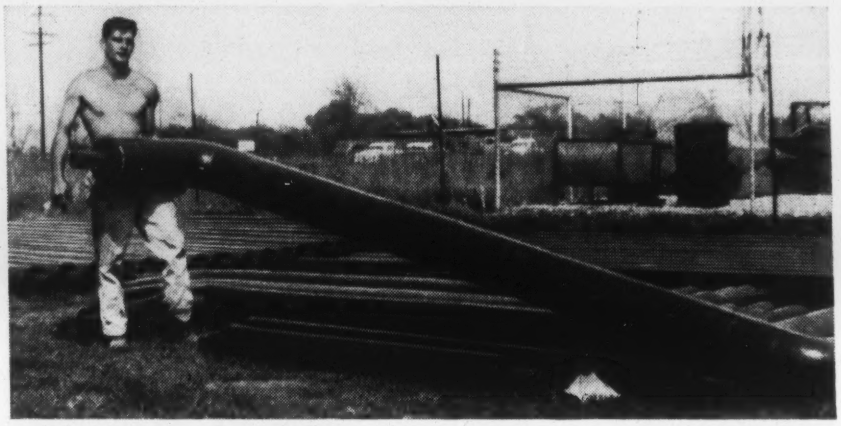
Johnson's Baby Oil
HALO SHAMPOO
Johnson's Baby Lotion
Johnson's Baby Oil
Johnson's Baby Shampoo

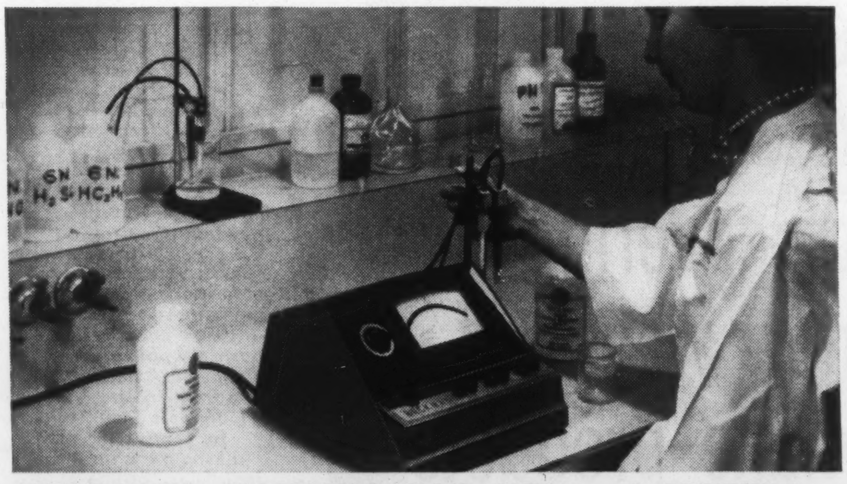
EYE-LURING COLOR CAPS BEST-SELLING PACKAGES

To compete for attention on crowded toiletry counters and shelves today, many best-selling products add a cap of colorful Beetle® Urea Molding Compound. The beauty of color—any color—is permanently molded in. Closures of Beetle Plastic are practical, too: they resist alcohol, acetone and other solvents, resist staining, and don't have an electrostatic affinity for dust, so stay clean longer on shelves.



NEW PIPE JACKET STOPS UNDERGROUND CORROSION

Strong jackets of spirally wrapped glass cloth and Laminac® Polyester Resin combat corrosion in new prefabricated insulated pipe conduit for underground steam and hot-water systems. Developed by Temploc, Inc., Baldwin Park, Calif., the protective two-ply shell is much lighter, less costly and more corrosion resistant than conventional steel or tar-protected conduit. Insulation is sealed and vapor-proofed at the ends by bonding the cloth-resin shell directly to the bare pipe. Field joints of insulation, cloth and resin are easily applied at the site.



IMPROVED HOUSING FOR NEW pH METERS

To make the housings for Pocket model and Zeromatic* bench model pH meters (shown) unusually strong, impervious to chemicals and resistant to scratching and chipping, Beckman Instruments, Inc., molds them of Cymel® 1077 Melamine Molding Compound. This tough, break-resistant plastic protects the delicate mechanism and also provides the attraction of color without the added production steps required in finishing metal. Color is part of the housing itself; there is no coating to wear or chip off . . . no metal to corrode. *Trademark Beckman Instruments, Inc.

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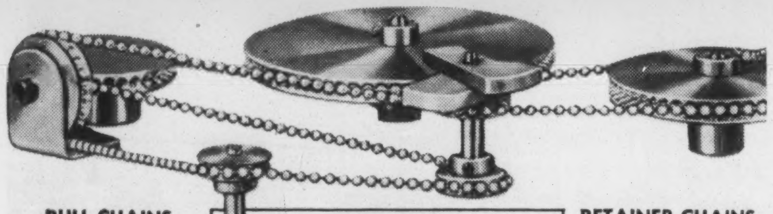

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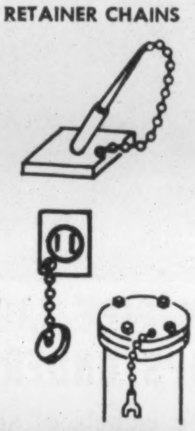

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DOOR CHECK
TAG CHAINS

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...for use with both hard and soft solders!

NICOTE is Frenchtown's new exciting discovery . . . a *single* metallic coating for refractory ceramic bodies which provides a surface for applying solders with melting points between 275° and 1000°. With NICOTE, no buffing, electroplating or tinning is necessary in most applications to form a strong, firmly-adhering bond with either *hard* or *soft* solders. NICOTE'S mechanical bond makes it ideal for hermetic seals, high strength mechanical seals, and vacuum applications. Bulletin 155 contains complete engineering details. Write for a free copy today!

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Precision manufactured from DuPont Nylon Resin to close tolerance of ± .001 on diameters and .0005 on sphericity, Ace Nylon Balls give **design flexibility and production economy.** Light in weight . . . tough at low temperatures . . . stable at high temperatures . . . resistant to corroding chemicals such as sulphuric acid, etc. . . . almost abrasionproof . . . these mass-produced balls have hundreds of industrial applications. Come in 14 standard sizes from 1/8" to 3/4". Complete facilities for fabrication of plastic parts for all industries. Estimates submitted promptly on receipt of blueprints or specifications.

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These 2 WELD NUTS
for blind assemblies
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- **Easier Positioning**
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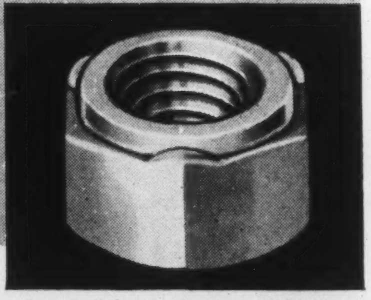
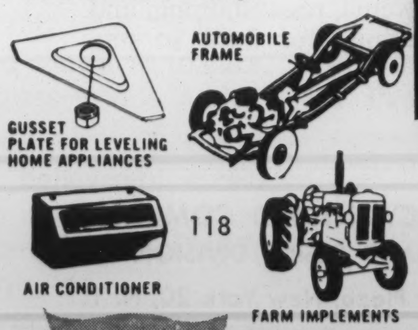
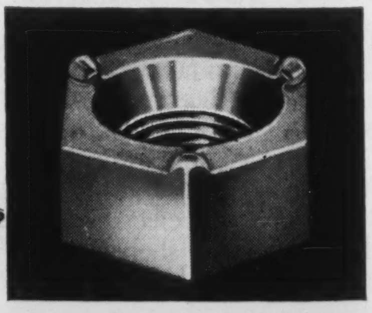


Gripco Pilot-Projection Weld Nut, circular pilot designed, provides quick, easy positioning of nut in bolt hole for instant resistant welding. No jigs, no fumbling, no waste of time. Weld spatter can not foul threads. Two heights for different metal gauges.

Available with or without Gripco locking feature. Three weld projections on bottom of nut provide a firm non-rocking electrical connection during welding. Write for samples and full details today.





Gripco Countersunk Weld Nut eliminates time-wasting retapping of nuts after welding. Exclusive countersunk nut bottom eliminates fouling of threads by weld spatter. No time wasting false starts, no cleaning of damaged threads, nut ready to receive bolt immediately.

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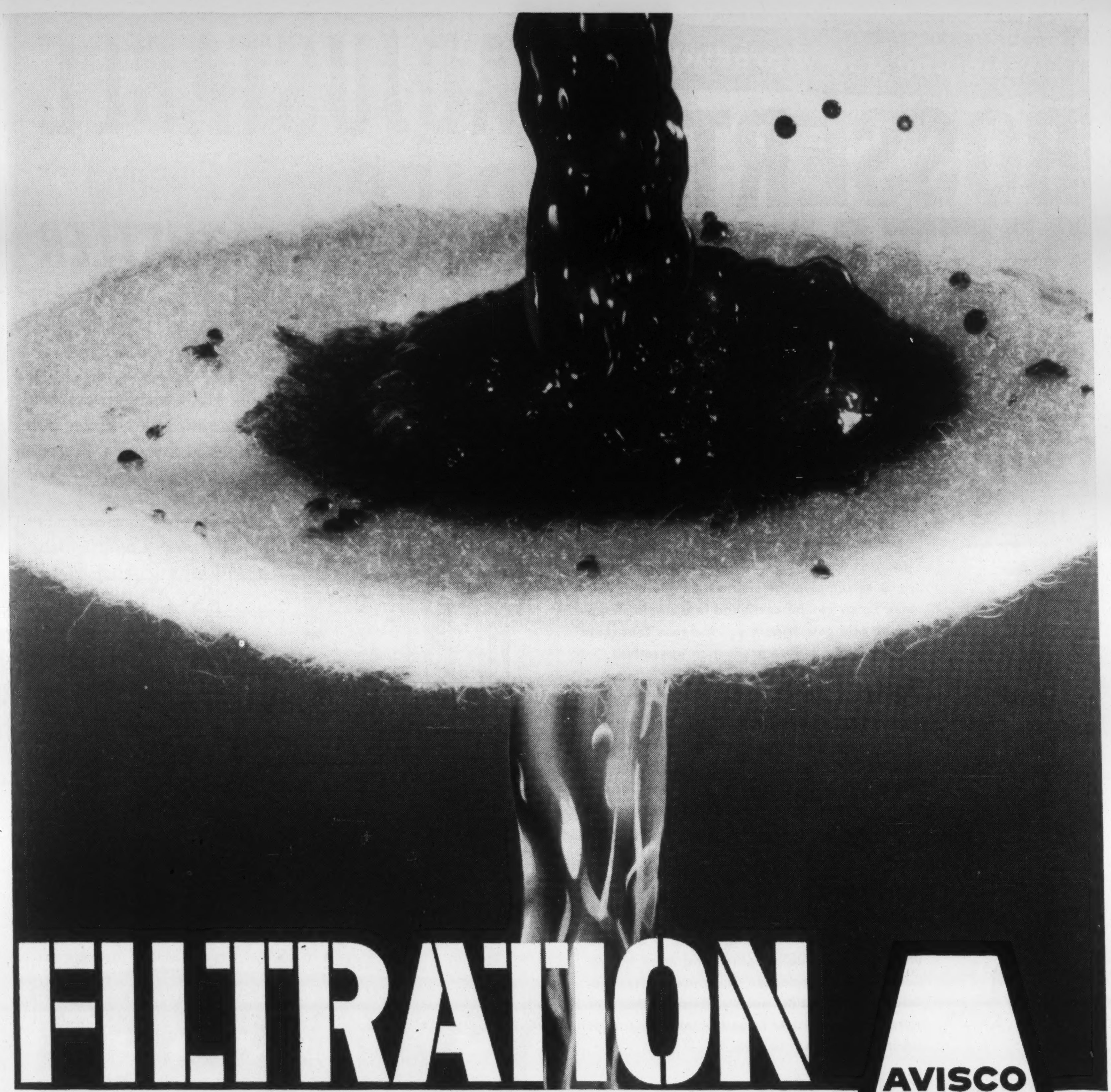

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What makes rayon superior in performance yet lowest in cost for all types of smoke, air and liquid filtration?

Man-made—First of all, rayon is a man-made fiber. That means its physical properties can be manufactured to meet specific filtration needs. Fiber size, weight, roughness and length can be carefully controlled during production so that the finished filter is tailored to do the exact job for which it was created. Further, rayon can be "crimped" or bent into tiny waves that increase the number of filter traps.

Non-channeling—Next, a filter made from crimped rayon staple does not channel—that is, the fibers form a barrier that keeps air, smoke or liquid from following straight paths.

Hooks and holds—The rayon fiber is rough-edged, too—tends to hook and hold passing impurities. Slicker fibers can't snag particles like rayon can.

Even-staining—Rayon stains evenly. This may be attributed only to high uniformity of filtration.

Controlled fiber length—The length of the rayon fiber is controlled, assuring better filtration at a steady, uniform flow. Uncontrolled lengths cause channeling and clogging, reduce efficiency.

Variety of densities—Most important, practically any filter density can be produced with rayon, due to the infinite webbing patterns possible with different deniers.

Low cost—All these superior filtering qualities come to you at lower cost than with any other filter fiber. Techniques for mass-producing rayon, developed over the past half century by American Viscose Corporation, make this low price possible.

Rayon filters simply cannot be matched for versatility, efficiency and low cost. We would be happy to show you further how you can use rayon filters for a more profitable business.

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You can design with unrestricted imagination when you plan to use metal stampings for parts or complete assemblies. Simple and complex forms can be combined in a single stamping to add new beauty . . . increase functional efficiency . . . reduce production operations.

Lighter weight . . .

Bossert can produce stampings in any metal or alloy, so you can take advantage of the weight-saving features of new, lighter metals. You can often replace a bulky, heavy casting or forging with a stamping, without sacrificing strength or durability.

Sturdier construction . . .

Stamped parts, assembled by welding, brazing, riveting or screw fastenings make a stronger unit, and are usually lighter and more attractive. Bossert's re-design department often develops stampings for parts and assemblies that were formerly cast or forged or machined, with substantial savings in costs.

Lower production costs . . .

In most cases, metal stampings can be produced with fewer production operations. They can often be formed in one piece, with holes punched to exact dimensional accuracy. This eliminates separate drilling, machining and assembling operations . . . and results in lower manufacturing costs.

Write for this illustrated booklet

This information-packed booklet describes Bossert's production facilities and engineering services. It will be helpful in planning your next product design job. Send for it today!

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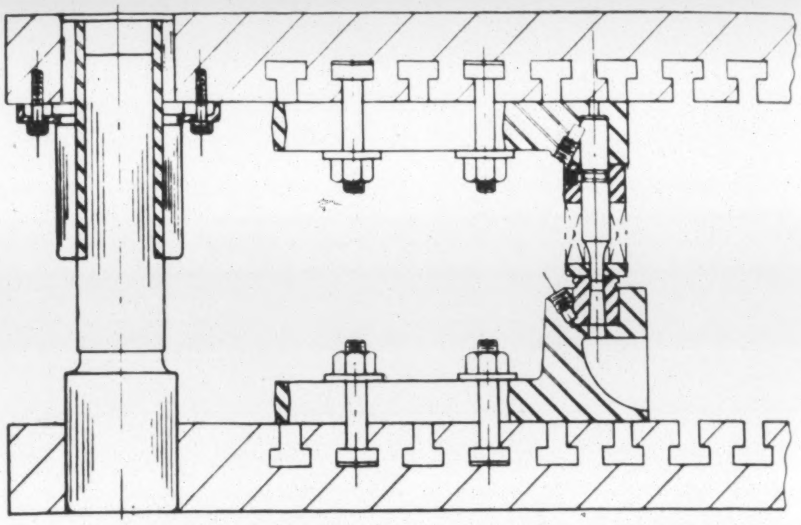
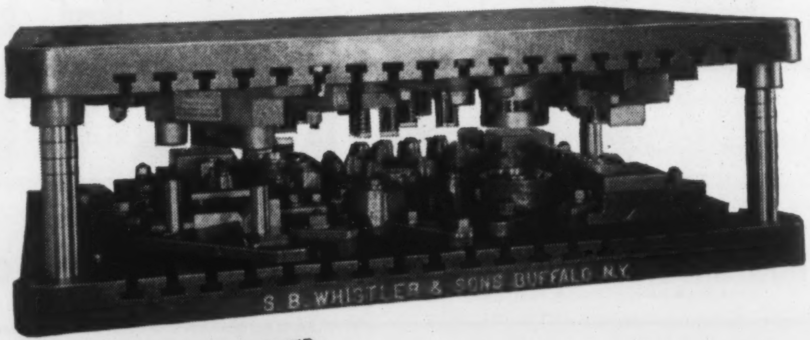


Above: Sectional drawing of a Whistler adjustable punch and die unit assembled in T-slot die set. **Below:** A completely assembled Whistler adjustable die ready for the press.



YOU NEED THIS CATALOG

to see for yourself in dollars and cents what this adjustable die making method can do for your plant. Send for it right now...without obligation.

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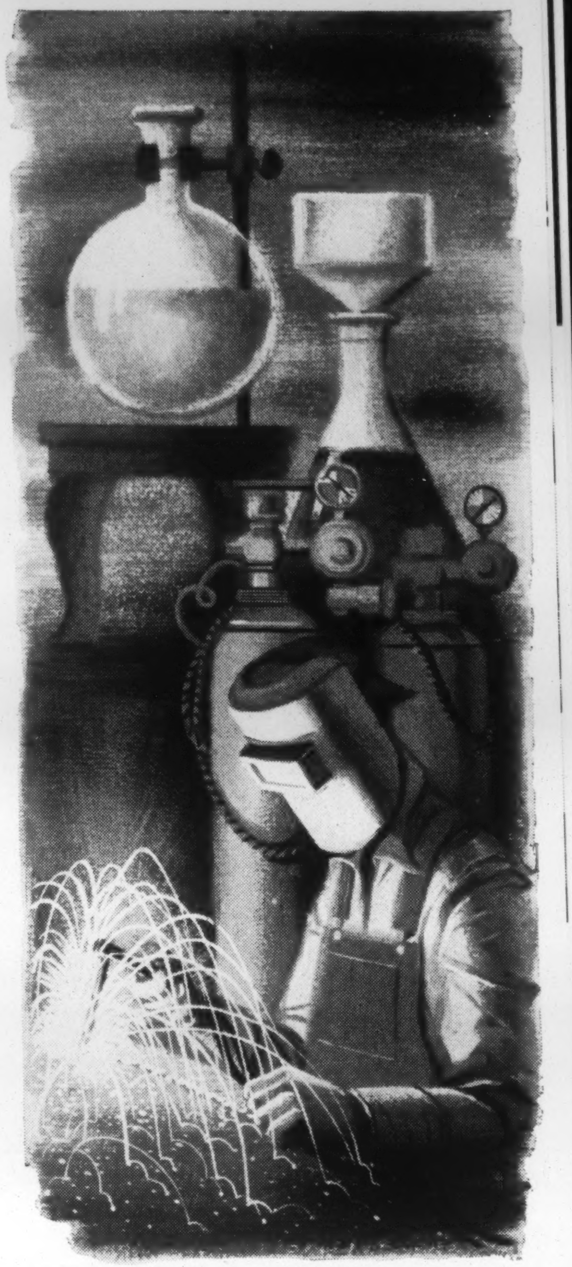
DIDYMIUM

A plentiful and economical rare earth mixture

a report by LINDSAY



You have often watched a welder at work, watched briefly that is, because the intense glare, even at a safe distance, forced you to turn your eyes away. And you wondered perhaps how it is that a welder, even with protective goggles, can focus his eyes on a welding spot for minutes at a time.

The secret, of course, is *Didymium.* The lenses in the welder's goggles, and in the glass blower's goggles, too, are made with didymium which completely absorbs yellow sodium light, thereby reducing glare and eye fatigue.

WHAT IS DIDYMIUM?

In 1842, a European chemist named Mosander separated from a crude rare earth mixture some material he called "didymium." He thought it was a new element. Actually it was a mixture of rare earths predominantly neodymium and praseodymium. Classically, didymium means a mixture of Nd and Pr. However, commercially, the name didymium is restricted to the cerium-free group of rare earths extracted from monazite ore, since the composition of the mixture is reasonably constant.

Didymium is the basic material from which all the other rare earths except cerium are produced. Lindsay produces didymium in various forms for different applications. For example:

Didymium Carbonate—pink powder, insoluble in water, soluble in acids.

Didymium Oxide—brown powder, insoluble in alkalis, soluble in acids.

Didymium Chloride—pink lumps, soluble in water and acids.

TYPICAL APPROXIMATE COMPOSITION OF RARE EARTHS IN DIDYMIUM MATERIAL

La_2O_3	45%
Nd_2O_3	38%
Pr_6O_{11}	11%
Sm_2O_3	4%
Other rare earths and yttrium oxides	2%

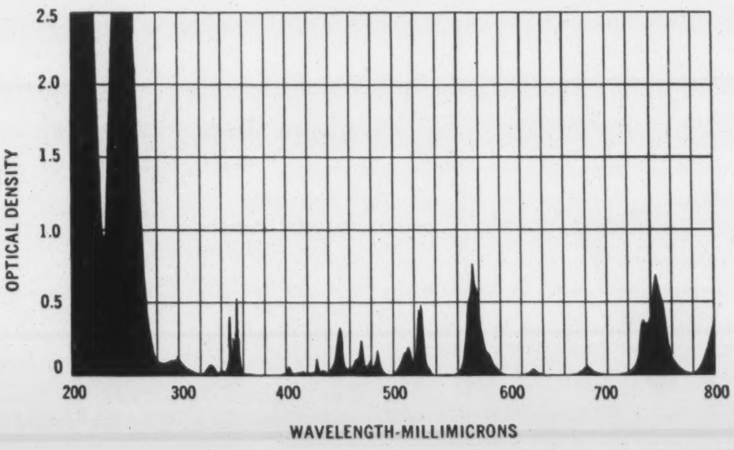
Didymium is one of the most economical forms of rare earth mixtures and is available for prompt shipments in carload quantities. It is useful for the coloring characteristics of Nd and Pr and for some of the other rare earth properties where purity is of secondary importance.

In addition to its extensive application in the production of lenses for welders' and glass blowers' goggles, didymium has other important uses. In coloring and decolorizing of glass. As a porcelain coloring agent. In light filters for calibration of instruments. To control the temperature coefficient of capacitance in barium-titanate ceramic condensers for radio and electronic use (U.S. Pat. 2,398,008). In stainless steels which are forged hot (U.S. Pat. 2,553,330).

We'd like to tempt you to investigate didymium and other rare earth salts as possible materials for use in your chemical and manufacturing processes. The very fact that important companies in a wide cross-section of industry, through their own research, have discovered profitable applications for the rare earths may intrigue your own research people.

We can be helpful to you and will be pleased to supply any information we can. Please keep in mind that we produce rare earths in purities up to 99.9% and higher in some cases (which is an achievement in itself). Shipments, depending on the salts you may need, can be made to fit your schedules in quantities from a gram to a carload.

Absorption Spectrum of
DIDYMIUM CHLORIDE SOLUTION
from monazite containing 1 g. rare earth oxide/100 ml. compared with water in 5 cm. cells



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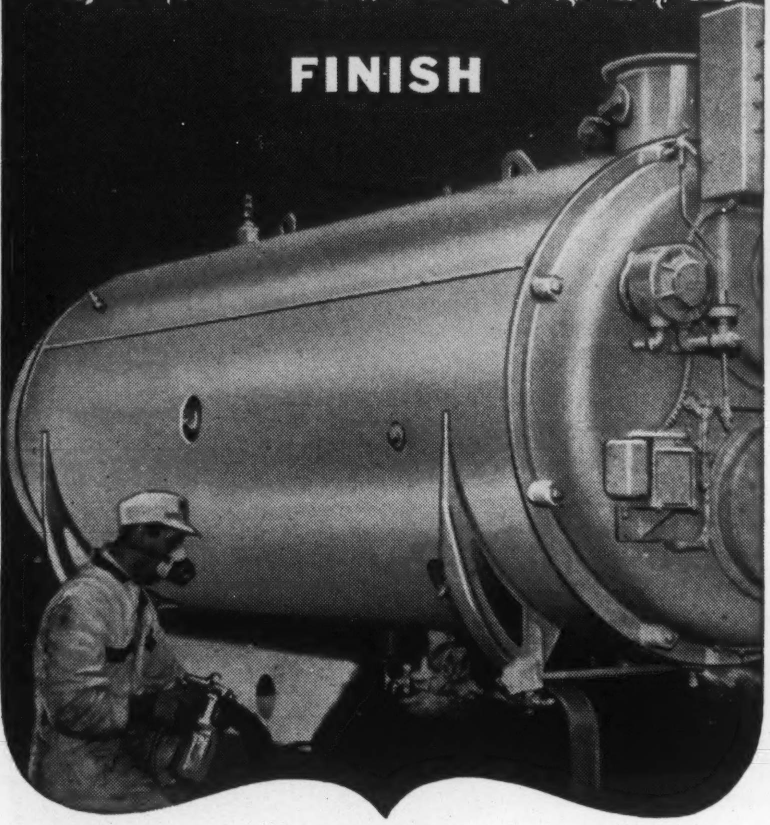

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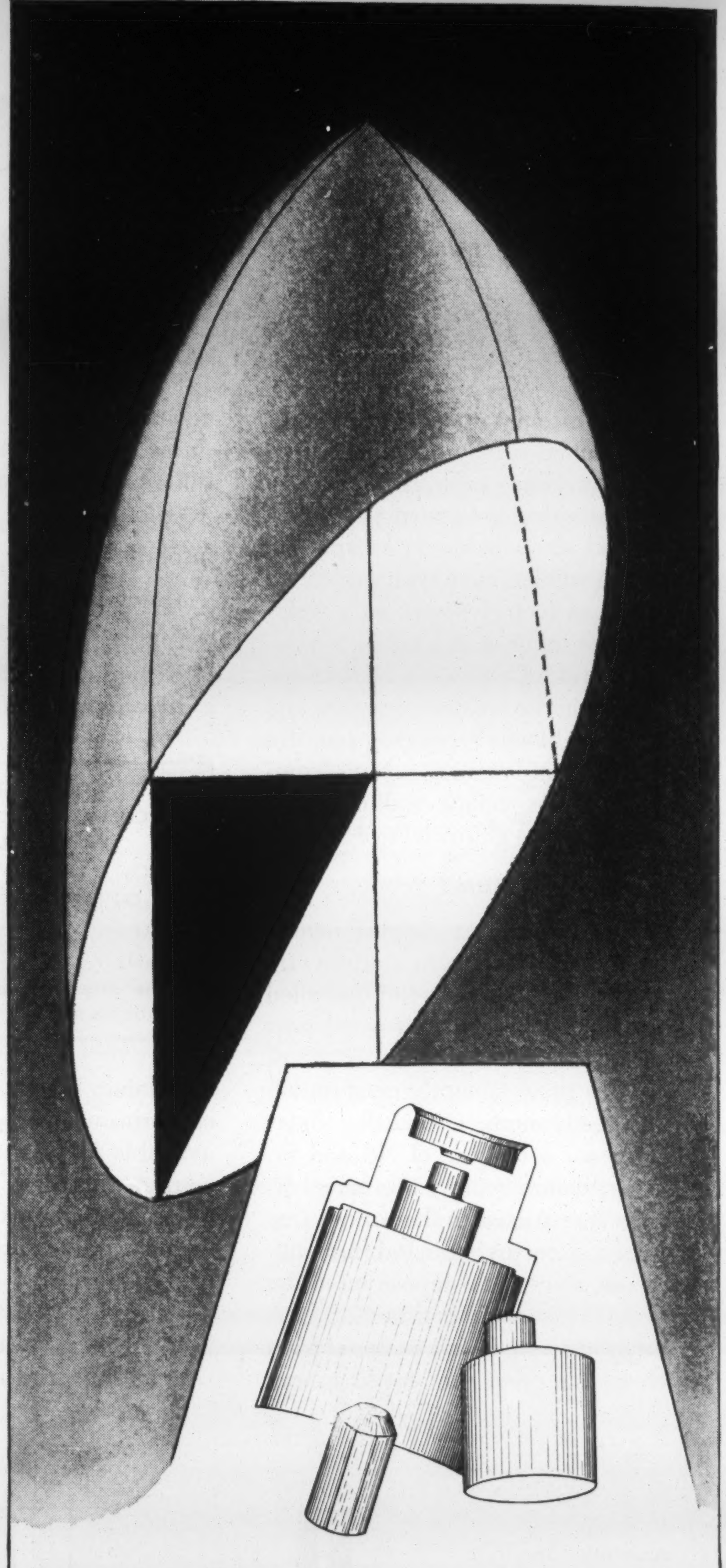
For more information, turn to Reader Service Card, Circle No. 400



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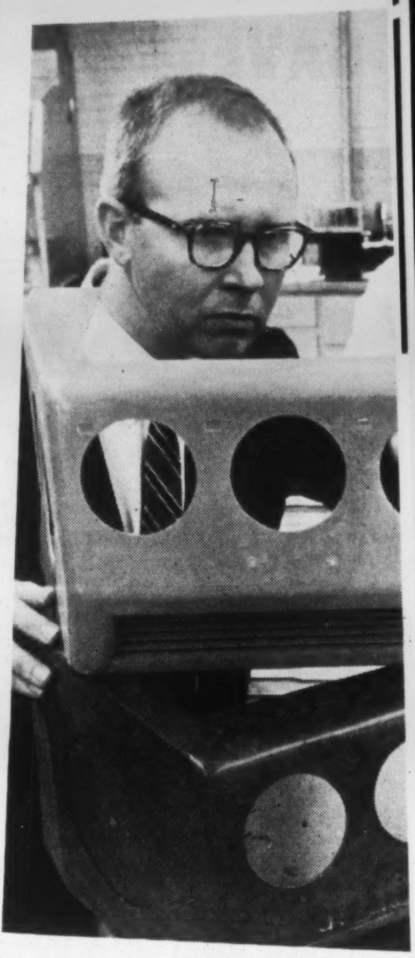

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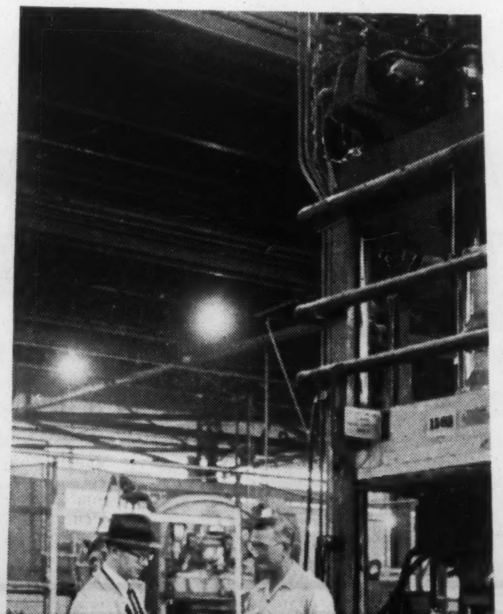

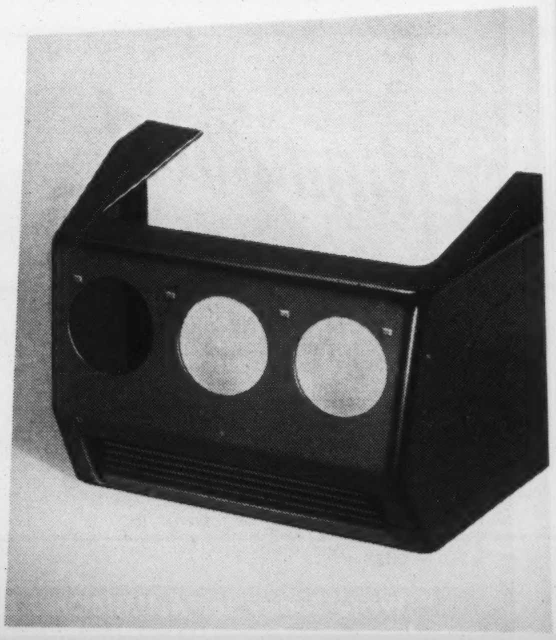

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- Counters and Shelves
- Traffic Panels
- Truck Bodies (Patented "Ribless" Construction)
- Truck Body Panels
- X-Ray Rooms
- Moisture-Vapor-Proof Rooms and Containers
- Decorative Finishes

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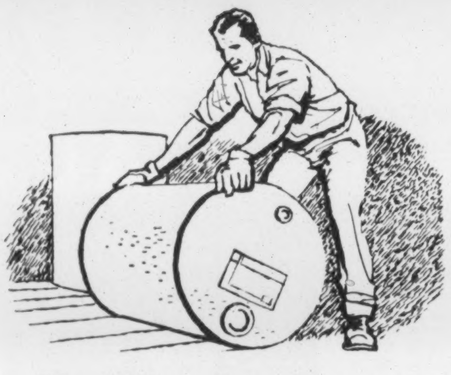
ANNOUNCING HETRON® 33

Get top-quality moldings at lower cost with this new Durez polyester



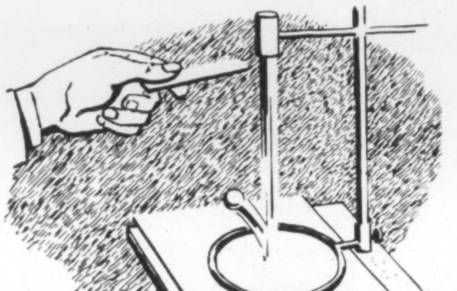
1. You'll be pleased, we think, with this new HETRON medium-viscosity semi-rigid polyester. It's just out of the lab and in *limited* commercial production. Its name is HETRON 33.

2. You can get outstandingly strong, crack-resistant laminates with HETRON 33. It's formulated especially to give you high-quality matched-die moldings. And you get them at *new low cost.*

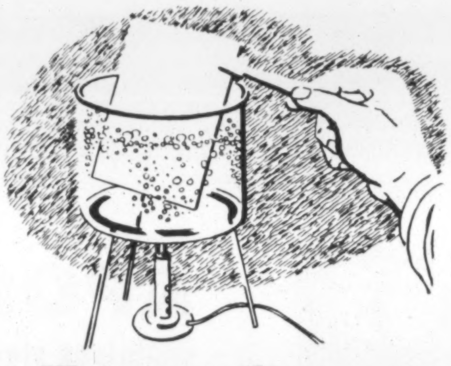
Flexural Strength, 73°F, psi	**40,900**
Flexural Modulus, 73°F, psi	**1.6×10^6**
Flexural Modulus, 180°F, psi	**1.0×10^6**
Tensile Strength, 73°F, psi	**21,500**
Tensile Modulus, 73°F, psi	**1.7×10^6**

TESTS MADE on 1/10" laminates containing 40% glass, 15% filler, 45% HETRON 33.

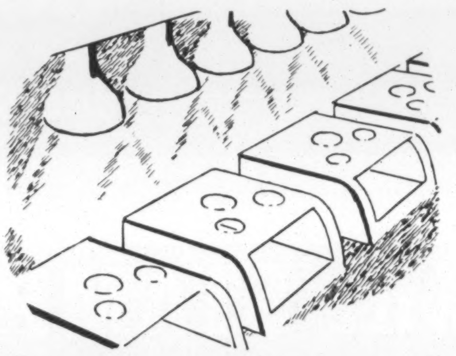
3. Imagine a semi-rigid resin with physicals like these for this type of laminate! HETRON 33 actually combines *resiliency* of a semi-rigid with *strength* of a rigid resin. And it gives you parts that *don't crack or craze.*



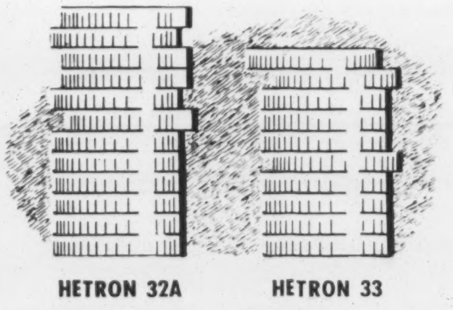
4. High reverse impact is another reason why you'll find HETRON 33 just right for parts that must stand up under rough usage. It minimizes rejects; cuts hand finishing up to 50%.



5. Wet strength is outstanding, too. Typical laminates retain 91% of flexural strength and flexural modulus after a 2-hour water boil. Water absorption after a 2-hour boil is only 0.1%.



6. Baked-on finish can be applied with excellent results to parts made with HETRON 33. Typical laminates can be baked at 350°F for 90 minutes, *several times,* without cracking or crazing.



7. Makes you more competitive on top-quality moldings. Because of research improvements, HETRON 33 gives you these properties *for less money!* Lower cost per pound, combined with lower gravity, saves you about 13%!

8. See for yourself how you can get superior moldings with HETRON 33—within a price range you and your customers can't afford to pass up! *Try this new resin on the toughest matched-die molding job now on your presses.* For a sample and technical data, just cut out this coupon, attach to your business letterhead, and mail today.

HETRON 33 has permanent, built-in flame resistance, too—but to a somewhat lesser degree than other HETRON *resins.*

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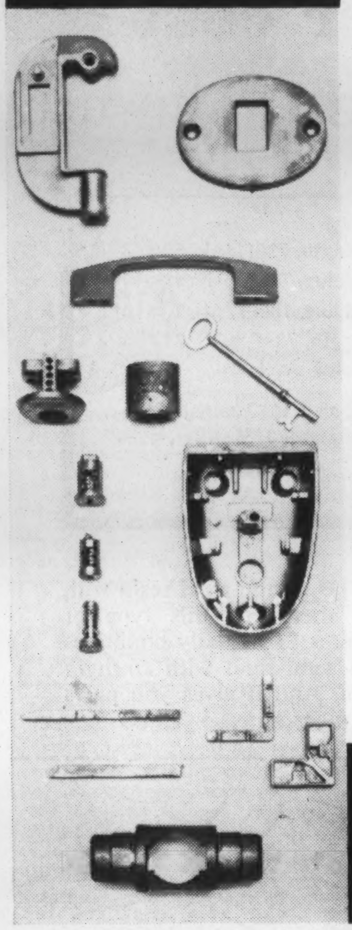
HARDWARE PARTS



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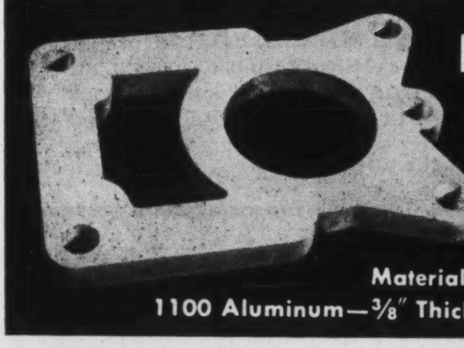
[illegible]	[illegible]	POLYSTYRENE

WILL STAMPINGS DO *YOUR* JOB BETTER ?



Material:
1100 Aluminum—3/8" Thick

Redesign from casting to stamping cuts piece price 66%...tooling cost 53%

★**BREAKAGE ELIMINATED**—Wrought aluminum alloy gives greater strength characteristics, eliminating breakage which occurred with the original cast part.

★**MACHINING ELIMINATED**—Blanked and pierced part is complete as pictured. No additional machining of holes or top and bottom surfaces is required. End result is a better part at lower cost.

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Tooling cost reduced 53%. Original cost of pattern and drill jig was $301.00. *Tooling for stamping cost $140.00.*

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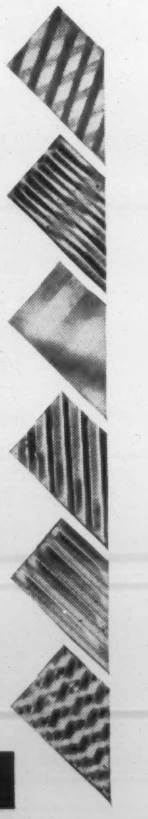
brass • zinc
aluminum READY FOR IMMEDIATE FABRICATION

pre-finished metals



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USE PANGBORN HYDRO-FINISH FOR:

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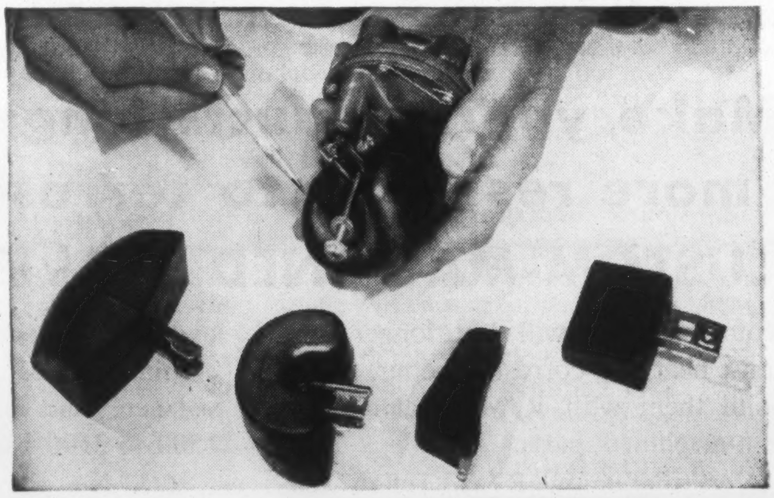

Why new PARKER Floats are better than cork or metal

Better than cork! Lighter, can be used in higher temperatures. Parker sealed-cell rubber floats need no protective coating, are resistant to fungus. Won't become waterlogged. Maintain stable weight and volume.

Better than metal! New Parker sealed-cell rubber floats won't fail from vibration or punctures. Can be drilled or machined.

Where can you use them? For all types of aviation and jet fuels, oil, water, and many other liquids. Can be molded in variety of shapes and sizes, with or without metal arm.

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Write for complete details.
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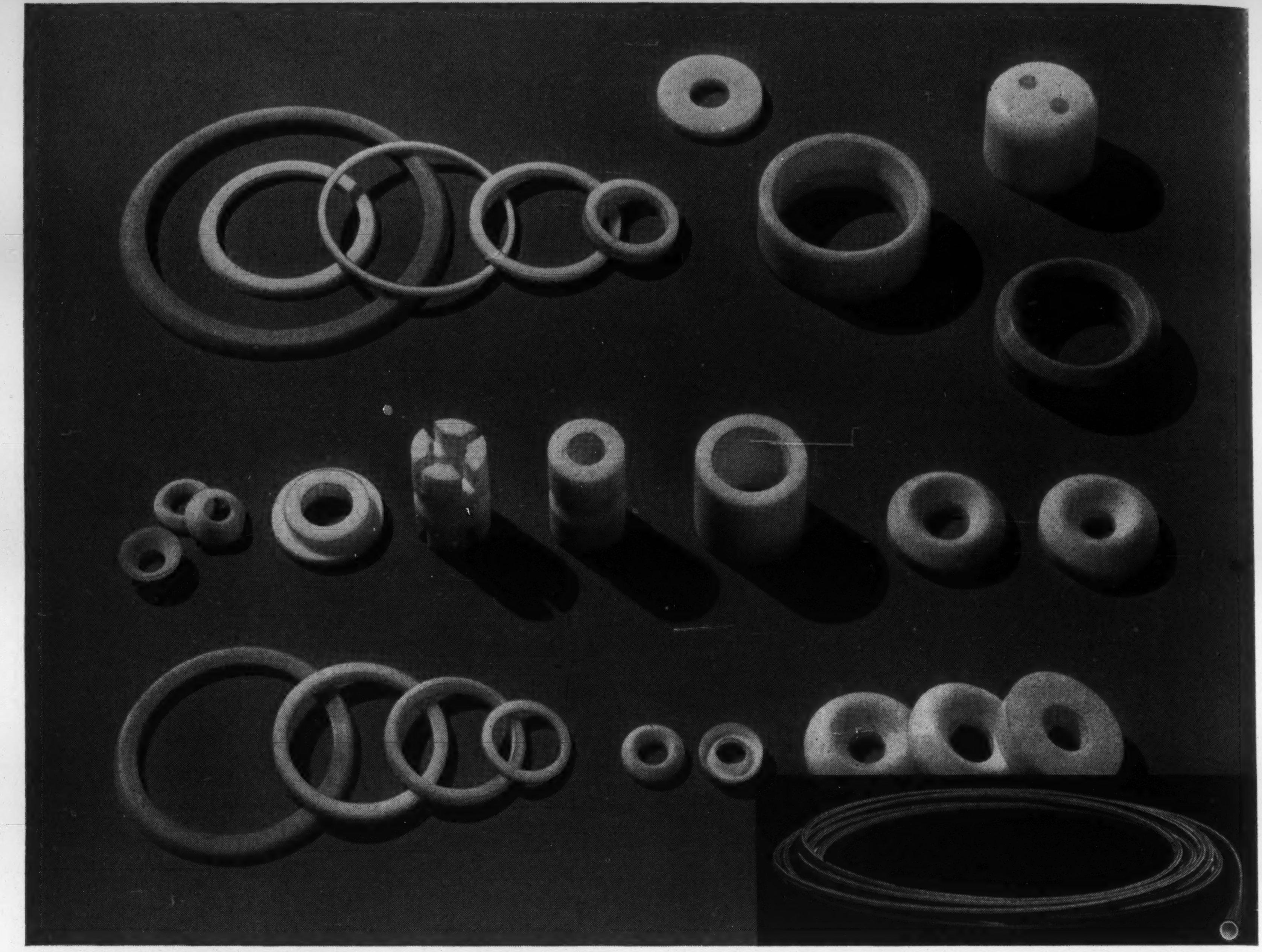

Typical R/M custom-machined "Teflon" parts. Inset: R/M Flexible Thin-Wall "Teflon" Hose, which R/M supplies in both wire-braided and rubber-covered forms.

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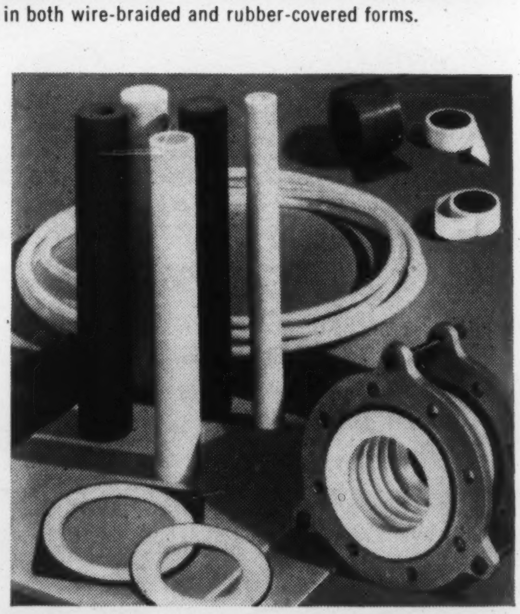
**A Du Pont trademark*



R/M also manufactures these products of "Teflon": rods, sheets, tubes and tape; centerless ground rods held to very close tolerances; stress-relieved molded rods and tubes; gaskets; expansion joints and flexible couplings; bondable "Teflon" sheets and tape; and Raylon (R/M trade name for mechanical grade "Teflon").

R/M

RAYBESTOS-MANHATTAN, INC.

PLASTIC PRODUCTS DIVISION, MANHEIM, PA.

FACTORIES: Manheim, Pa.; Bridgeport, Conn.; No. Charleston, S.C.; Passaic, N.J.; Neenah, Wis.; Crawfordsville, Ind.; Peterborough, Ontario, Canada

RAYBESTOS-MANHATTAN, INC., Engineered Plastics • Asbestos Textiles • Mechanical Packings • Industrial Rubber • Sintered Metal Products • Rubber Covered Equipment
Abrasive and Diamond Wheels • Brake Linings • Brake Blocks • Clutch Facings • Laundry Pads and Covers • Industrial Adhesives • Bowling Balls

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▸▸▸ USING

DU PONT ELASTOMERS

neoprene · Hypalon® in design

"Non-skid" neoprene reels help dye slippery synthetic fabrics

Gaskets of HYPALON unaffected by 2% ozone after two years' use

For two years, a large chemical firm has used gaskets of HYPALON in its ozone generators. Despite constant exposure to 2% ozone, not one gasket failed because of ozone cracking.

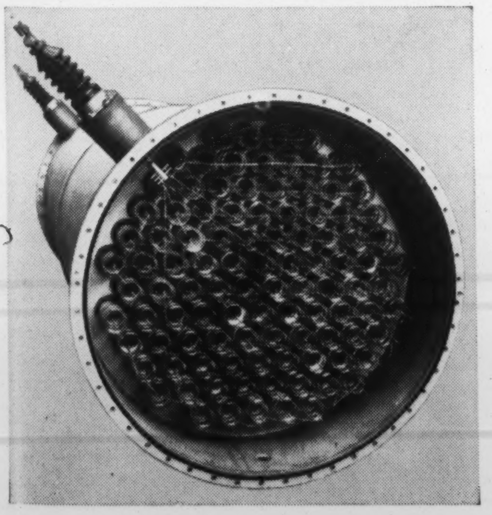
The ozonator is a steel shell packed with glass tubes. As dry oxygen passes through the tubes, it is converted to ozone by high-voltage electrical discharge. Each end of the shell is closed by a dished head sealed with a gasket of HYPALON.

Plastic gaskets too rigid

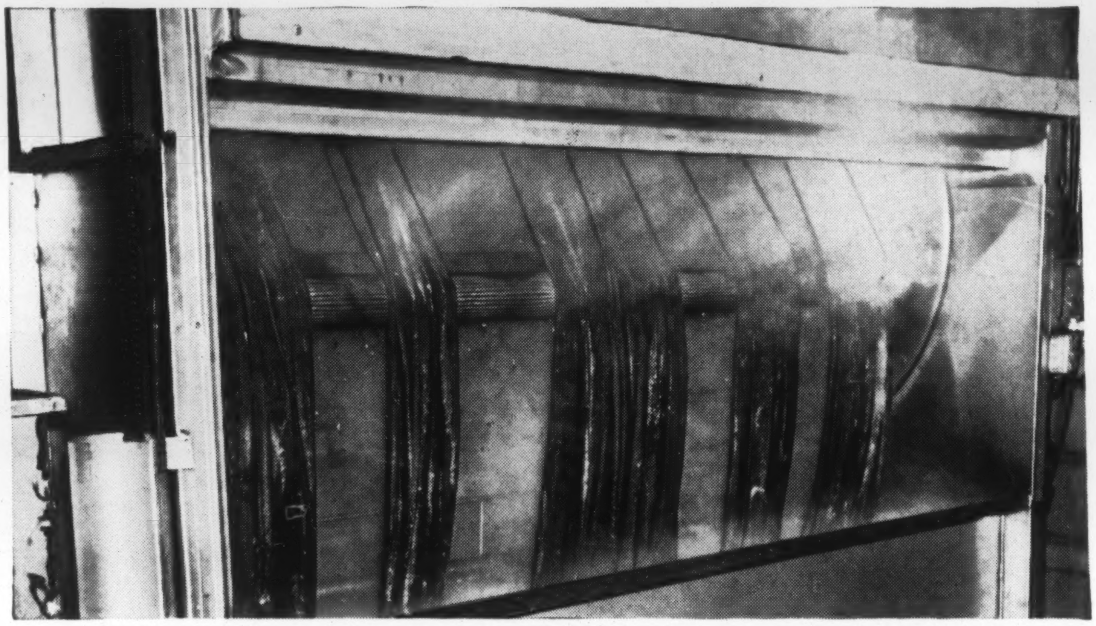
Plastic gaskets, which were formerly used in the generators, were unaffected by ozone, but took a permanent set under flange pressure. When a head was removed for routine maintenance the plastic gasket was too distorted to put back. Gaskets of HYPALON are reused.

Designing with HYPALON

HYPALON offers many additional advantages compared to other types of rubber. It resists strong oxidizing acids; can operate at temperatures from 250° F. to 350° F.; resists weather and sunlight. This Du Pont synthetic rubber can also be compounded in an unlimited range of stable colors. HYPALON offers extra long life and lower operating costs in jobs where conditions are severe. Just mail coupon for full information.



Gaskets made of HYPALON seal each end of this ozonator; they show no deterioration after two years in service.



Fluted neoprene bars show little wear after four years in dye machine. Dye bath may be acid or alkaline, oxidizing or reducing. Temperature is 200° F.

Mill uses neoprene to get needed traction for hauling fabric through dye bath

Chatham Manufacturing Co., of Elkin, N. C., used neoprene to solve an unusual problem in dyeing synthetic fibers. Long loops of the fabrics are dyed in stainless steel piece dyeing machines. Loops, often 100′ long, are pulled through the dye bath by means of a reel. The slow rotation of the reel assures even dyeing over the full length of the goods.

The progress of the fabric depends entirely on friction between reel and loop. When several types of metal reels failed to produce enough friction to pull the smooth synthetic fabrics through the bath, Chatham designed special fluted neoprene bars for the reels. They provided adequate traction and ended the problem of slippage and uneven dyeing.

Chemical resistance important

Bars covered with natural rubber could have solved the traction problem but neoprene was chosen for its excellent chemical resistance. In dyeing various fabrics the dye bath may be acid or alkaline, oxidizing or reducing. Each dyeing cycle requires 3-5 hours at 200° F., and the dye machines operate 24 hours a day. Ordinary rubber just couldn't stand this treatment. Chatham's Superintendent of Dyeing, Mr. V. Caton, reports that neoprene has given excellent service for four years with little wear.

Neoprene's resistance to chemicals, heat and abrasion means long-term wear—and economy in many types of service. Mail coupon below for full details on how neoprene can work for you.

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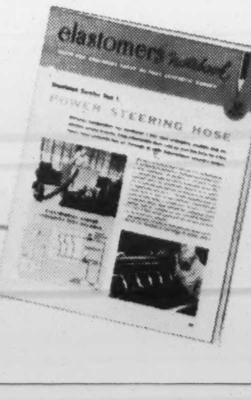

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TO get the continuous, fast operation vital to making the most of your automatic forging production lines, you need uniformity in the steel you use. High speed heat-treating and hardening operations are often interrupted by changes in chemical composition and structure of steel used. Uniformity cuts interruptions for adjustments. It helps you gain the full advantages of automatic operation. And you get the utmost in uniformity—at no extra cost—by using Timken® electric furnace fine alloy steel. It's uniform from bar to bar, heat to heat, order to order.

We take many extra quality-control steps to insure this uniformity. Some of them were "firsts" in the steel industry. For example, a magnetic stirrer for molten steel assures equal distribution of alloys, uniform temperature and working of the slag. And the Timken Company was also first to use a direct-reading spectrometer to insure uniform grain size and chemical composition right to the instant the heat is tapped.

To further assure uniformity, your order of Timken fine alloy steel is handled individually. We target our conditioning procedures to meet your end use requirements. Each bar is stamped to identify the heat it came from. This limits variations within an order as well as from order to order.

So to step up your automatic forging operations—at no extra cost—always specify Timken fine alloy steel. You'll get uniform results, faster, continuous production, time after time. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

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